ENGINEERING NEWS

THE LONG SPAN BRIDGE CO. proposes to bridge the Detroit river. The Chief Engineer is Mr. GUSTAV LINDENTHAL, M. Am. Soc. C. E., and his plan embraces a bridge of three spans, with 150 ft. clearance below for vessels. No further details are yet given, but a bill is before Congress asking for the privilege of erection.

THE PROPOSED CANADIAN PACIFIC EXTENSIONS to compete for territory now controlled by the Grand Trunk system, may perhaps never be built. The plain speech of Sir HENRY TYLER at the Grand Trunk meeting some weeks ago, has brought into prominence the fact that for these two great corporations to enter into a fierce struggle of competition and vie with each other in building parallel lines in their war for territory, means loss of dividends for both and probable bankruptcy for one. A large proportion of the securities of both companies are held in England and their holders are none too well contented with their past returns from their investment in "Canadians", and look with no pleasure on the prospect of a war of extermination between the two properties. A movement is on foot to form an association of the stockholders of the two companies, which shall exercise some control over them, and prevent undue competition and the construction of parallel lines. It is even possible that the Canadian Pacific extension from London to Windsor, which is already under way, will be given up. The English financial journals all unite in demanding this, which, indeed, is the principal cause of the present stir.

A CHEAPER SLEEPING CAR SERVICE is the object of an extension of the business of Barkalow Bros., of Omaha and Denver. They now run 17 cars between Omaha and Ogden, and will soon put others on between Denver and Kansas City. The cars have comfortable berths, upper and lower, hot and cold water, and other conveniences. The feature of the service is its cheapness. For a berth, 50 cts. per night is charged, and the total expense to the coast is $2.50. They are intended for tourists and second-class passengers only.

SMITH'S AND PETTY'S ISLANDS, in the Delaware river at Philadelphia, are to be condemned and removed, if the States of Pennsylvania and New Jersey will appropriate $900,000 for that purpose. The U. S. Government has set aside $300,000 as a limit, and the owners want $1,300,000. The improvement will narrow and deepen the river in front of the business part of the city and enable the extension of wharves and the docking of larger steamers.

THE JACKSONVILLE BRIDGE CO. has let the contract for substructure of its bridge across the St. Johns river (which will be used when completed by the Jacksonville, St. Augustine & Halifax River Railway Co. to cross the river) to Messrs. ANDERSON & BARR of this city. The central draw pier is a cylinder 28 ft. in diameter, of ⅝-in. steel. The 4 other piers consist of 2 10-ft. cylinders, also of ⅝-in. steel. The cylinders are to be sunk by the usual pneumatic process to a maximum depth (to rock) of 90 ft. below water, the water being 50 to 60 ft. deep. The cylinders when sunk will be filled with Portland concrete, about 1 to 5, more or less, of the best quality. The foundations complete are to be finished May 1, and will rest on rock, the material above being mostly river mud. The caissons are made in 5 ft. sections, strongly braced together, and will probably be capped with a metal plate without masonry. Messrs. MORISON and CORTHELL are the Engineers.

THE CHARLESTON JETTIES have been reported upon, under date of Nov. 10, by a board of U. S. Engineers made up as follows:—Col. CRAIGHILL, Lt. Col's. GILLESPIE and KING and Major POST. The board recommended that the two jetties be brought to mean low water level by mattresses ballasted with stone, and that the work above this level be determined by the observed effect of the construction upon the channel bottom. Stone blocks of 1 or 2 tons weight are recommended for the upper part the jetties instead of [illegible] and uncertainty of the latter in use. A depth of 15 ft. and width of 350 ft. is proposed in the channel.

THE PANAMA CANAL AFFAIR is fast getting no better. Since our last issue M. de LESSEPS has resigned the Presidency of the Canal Company and the French Chamber of Deputies has refused to consider a bill postponing payment of interest on the canal bonds and looking towards a reorganization of the company on a new basis. There has been some talk of an attempt to enlist American sympathy in an attempt to complete the work on a plan of action not made public. But as an investment of less than $500,000 measured the past interest of this country in the French canal, it is very improbable that more money can be secured under present conditions, at least as long as it remains a French enterprise under French direction. Americans will soon have a canal of their own to build if they are inclined that way.

SHARP RAILWAY PRACTICE is evidently not confined to competing American traffic managers. The *Novoe Vremya*, of Russia, says that E. ROTHSCHILD, who controls the best naptha springs in that country, refuses for weeks at a time to empty the tank-cars consigned to him at Batoum and thus blocks the tracks and deprives his rivals of the use of the wagons. Of course he must pay demurrage; but in the mean time he has a virtual control of the market.

THE CAST STEEL GUN, made at Thurlow, Pa., by the Standard Steel Co., is to be tested at Annapolis as soon as the wreck made by the Pittsburg gun's failure can be cleared away. This is a larger gun than the other and is made of open-hearth instead of Bessemer steel. Like the first it is a bored-out casting, but the difference in the mode of manufacture may be vital.

THE SOUTH EASTERN RAILWAY, of England, has put upon its line some new composite passenger cars, 50 ft. long and divided into 4 first and 3 second class compartments. The bodies of the cars rest on two bogie-trucks of 4 wheels each. The *Railway Press*, of London, says of these cars that they require 17½ per cent. less power to draw them than is required with the chain-slung carriages, and at the same time "do away with the great wear and tear of wheels and permanent way and give to the passenger ease and comfort not possible to obtain in the older types of rolling stock." The passengers would be more comfortable still if the compartments were done away with altogether, or reduced to two. But our brethren across the sea will come to it after a while.

MOVABLE STREET PAVEMENTS are suggested in an editorial in *The Engineer* as a remedy for the nuisance of frequent breakage of the street surface and the impossibility of proper repair. Assuming that subways for sewers and all pipes are the proper remedy, but too costly, our contemporary suggests a form of pavement in large slabs that can be readily lifted, resting on an iron framework supported in turn by short screw or flange piles. Under this pavement would be an open space of one or two feet, and just below this the sewers, mains, etc The advantages claimed are freedom of access to underground plant without the present disadvantages of the blocking of traffic and breaking into a solid street covering. The cost is admitted to be great, but it is thought that this would be counterbalanced by the gain in maintenance. As in our cities, water, gas and steam-heating mains and electrical conduits are the real sources of trouble, a subway for these alone, leaving the sewers to take care of themselves, would cost less and be quite as efficient as the movable pavement.

THE HEAVY RAINS of recent weeks have caused many serious floods and freshets. At Fall River, Mass., the bursting of a dam at the Watuppa Ponds, which are very full, is apprehended. The Lackawanna river overflowed on Dec. 18, and caused much damage in Scranton, Pa., and along the valley. At Albany, N. Y., a 15 ft. freshet submerged the piers and river front and hindered traffic on the Susquehanna and West Shore roads. Washouts have occurred on the Central Massachusetts, Fitchburg, Boston & Maine, and New York & New England railways; on the latter road the limited express was ditched Dec. 18 by a washout near East Thompson, Conn. A landslide in the Kearny cut, on the New York & Greenwood Lake Railway, caused considerable interference to traffic Dec. 17. ——A cave-in in a tunnel on the Virginia & Truckee City Railway, at Virginia City, Nev., stopped traffic for a few days.

A SCAFFOLDING ACCIDENT occurred Dec. 14 at Steven's Point, Wis. Ten men were at work on the inside of the water-works stand-pipe, in course of construction, and were engaged upon the scaffolding nearly 90 ft. from the foundation. Without a moment's warning one side of the scaffolding gave way, precipitating five of the men to the stone bottom; four were killed and one seriously injured. The foreman narrowly escaped with his life, being inside at the bottom of the pipe when he heard the crash above, and sprang through the manhole not a moment too soon.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On Dec. 18, a freight train on the Cincinnati, Jackson & Mackinaw Railway broke through a trestle near Augusta Mich., and 13 cars went down. Two men were injured.——On Dec. 19, the wooden bridge across the Merrimack river on the Suncook branch of the Concord Railway gave way while being repaired, the ice and high water having started the insecure temporary false-works. Three men were killed.——On Dec. 19, the flood caused some damage to the false works of the new iron railway bridge being built at Selins grove, Pa.——On Dec. 17, a trestle work on the Fitchburg road, 50 ft. long, over the Deerfield river at the east portal of the Hoosac tunnel, was swept out by the ice. The rail way company has been replacing the old wooden bridge with a modern iron one, but in this case it was necessary to build a trestle work slightly above the old bridge and this has been in use for some time while the new bridge was being built.——The Windsor & Annapolis Railway bridge at Cambridge, N. S., has been carried away by a freshet Three dams above the bridge gave way, and the heavy volume of water pouring down was too much for the structure. It will be some time before trains can again cross.——Several bridges on the Pleasant Valley line of the Lehigh Valley road have been washed away.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Dec. 13 between a freight and a passenger train on the Chicago, Milwaukee & St. Paul, near Reed's Landing, Minn. The engines and several freight cars went down a 20 ft. bank. One man was killed and two injured.——A rear collision between two sections of a Philadelphia & Reading freight train occurred at West Milton, Pa. Dec. 13. The engineer was killed. It was said by railroad employees that in the 48 hours while on duty he had but 2 hours of sleep. The coroner's jury gave the following verdict: "That the engineer failed to do his duty on account of want of sleep, and that the flagman should have taken more precautions.——On Dec. 15 the engine of a Cleveland, Loraine & Wheeling passenger train jumped the track on a trestle over Morgan's river, near Wheeling, W. Va., broke its coupling and went over the structure, falling 30 ft. The engineer was killed.

THE CHICAGO SEWAGE TUNNEL SCHEME, proposed sometime ago by Mr. NOTT, of that city, and again being advanced by him, means a 26-mile tunnel towards Joliet, and incidentally a complete new sewerage system for Chicago. The *Tribune* of that city suggests that a little more knowledge of elementary chemistry on Mr. NOTT's part would have saved him much useless figuring and letter writing, and suggests that the citizens of Joliet might object to having poured out at its doors the sewage of Chicago in as filthy and high flavored a condition as when it left the latter point. Mr. NOTT in his plan neglects the useful effect of free exposure to air in deodorizing and rendering the sewage comparatively innocuous.

SLIGHT EARTHQUAKE SHOCKS were felt in Washington and Warren counties, N. Y., and in the Catskill mountains, early in the morning of Dec. 19.

The Cleveland Central Viaduct.

The new Central Viaduct was formally turned over to the people of Cleveland, O., on Tuesday, Dec. 11, with military and civil parade, a short speech by the Mayor and an elaborate banquet in the evening. Cleveland now possesses four viaducts among its 60 bridges, vindicating its right to the title of "The City of Bridges."

We are indebted to Mr. WALTER P. RICE, City Civil Engineer of Cleveland, O., for the following description of this interesting work, and also for the plans accompanying it and for photographic views of the structure in process of erection, which latter we will reproduce in another issue.

What is known as the Central Viaduct, one of the most important engineering works undertaken by the city of Cleveland, was authorized by the Common Council on Dec. 14, 1885, and the contracts for substructure and superstructure were approved on March 29 and April 12, 1886, respectively. Ground was broken at the south pier of the Cuyahoga river crossing on May 5, and at the crossing of the Walworth river valley, at abutment No. 3, on April 26, 1886. Work on the superstructure was commenced in October of the same year at the Walworth run portion, and in October 1887, at the Cuyahoga river.

Generally described, the viaduct sends forth an arm over each of the two valleys of the Cuyahoga and Walworth streams, these two arms uniting on the V-shaped bluff at the junction of these streams, as shown on the general plan. The total length of the structure, including approaches, is 5,229 ft. The roadway is 40 ft. wide with two 8 ft. sidewalks, making a total width of 56 ft. and the length of floor is 1,092 ft. and 2,839 ft. over the two valleys.

The work on the Walworth Valley portion was commenced on the east abutment on April 26, 1886, as before stated, and the west abutment was completed on November 26 of the same year. The quantities embraced in this part of the work were as follows:—Excavation, 15,760 cu. yds.; concrete, 1,836 cu. yds.; masonry, 5,209 cu. yds., and protection timber work, 117,418 ft. B. M. Dredging for the river foundations was commenced on May 5, 1886, and work was suspended for the winter on December 6, with the west abutment finished, 19 courses of masonry on the east abutment, 9 courses on the center pier and one course on the north pier.

The center pier was founded on 483 piles cut off 23.2 feet below city datum. These piles had a top average diameter of 14 in., at cut off, and an average penetration of about 39 ft. On these piles was set a timber crib 17 ft. high, made of 12×12 in. oak and pine timbers. Though originally designed as octagonal, with four open wells, it was deemed advisable to build it up solid, and this was done. The masonry was commenced 6 ft. below city datum, or 4 ft below the average stage of water. The quantities in this pier were 27,490 lin. ft. of piles; 355,926 ft. B. M. of oak timber and 83,244 ft. B. M. of pine timber; 57,369 lbs. of iron bolts, etc., and 2,190 cu. yds. of masonry in the pier.

The north and south piers were founded on 312 piles in each, cut off about 20 ft. below city datum, with an average top diameter of 13½ ins. and a penetration of about 34 ft. In each case the piles were capped by a solid crib of 12×12 in. timber, about 14 ft. high, supporting the masonry. The quantities in each pier were about as follows:—16,600 lin. ft. of piles; 216,000 ft. B. M. of oak timber and 45,000 ft. B. M. pine timber; 37,670 lbs. iron and 1,435 cu. yds. of masonry. All substructure was practically completed on Dec. 6, 1887, with the setting of the last stone on the center pier. The superstructure over the two valleys may be classified as follows;

The Walworth Run section of superstructure has a total length of 1,092 lin. ft. made up of 12 spans of 30 ft. each, 6 of 60 ft. each, and 5 other spans ranging from 32 ft. to 120 ft. in length. The Cuyahoga Valley section has a total length of 2,839 lin. ft. with 41 spans. There are 20 spans of 30 ft. each, 3 of 60 ft. each, 2 of 75 ft. each, 2 of 90 ft. each, 2 of 120 ft. each and 2 of 135 ft. each, with 11 spans of odd lengths ranging from 43½ ft. to one draw-span of 236½ ft. The total length of superstructure is thus 3,931 lin. ft., and the elevation of the roadway above the ordinary stage of the river is 101 ft.; above the Central Way it is 89 ft. and over the N. Y. C. & St. L. R. R. it is 33 ft. As before mentioned, the viaduct has a total width of 56 ft., or 40 ft. of roadway and two 8 ft. sidewalks.

The flooring is made of long-leaf Southern pine, 7 to 12 ins. wide, faced on one side to a uniform thickness of 3½ ins. A caulking seam is formed by a bevel of 1-16 in. 1½ ins. long. On top of this floor is a pine-block pavement 5 in. deep. The sidewalks are also made of Southern pine, in planks 5 to 8 ins. wide and faced to a uniform thickness of 3 ins.

The turntable of the pivot span is 31 ft. in diameter, with 12 bearing points on the draw and 44 wheels of 8½ in. face and 18 in. diameter. These wheels are made of a special composition of cast-iron and steel borings. The turn-table track was leveled by using a composition of sulphur 9 parts and coal-tar 1 part, previous experiments with this composition showing a maximum resistance of 4,800 lbs. per sq. in. after 21 hours set in a temperature of 70° Fah., the testing piece being 1×1×⅝ ins. In the test this piece was reduced in volume to ⅛×⅛×⅝ ins. The advantages of the coal-tar addition are that the composition will not "blow" as much as lead or pure sulphur; it is very fluid and combines well on repouring, and it is claimed it will neutralize the destructive effect of the sulphur on the metal.

The bridge will be lighted by 2000-candle power electric arc lights pendant from wires over the center of the roadway; the lights being spaced at intervals of 270 ft. The street railway which is to cross this bridge will also be propelled by electricity.

The quantities and materials entering into the construction of this bridge may be summarized as follows:

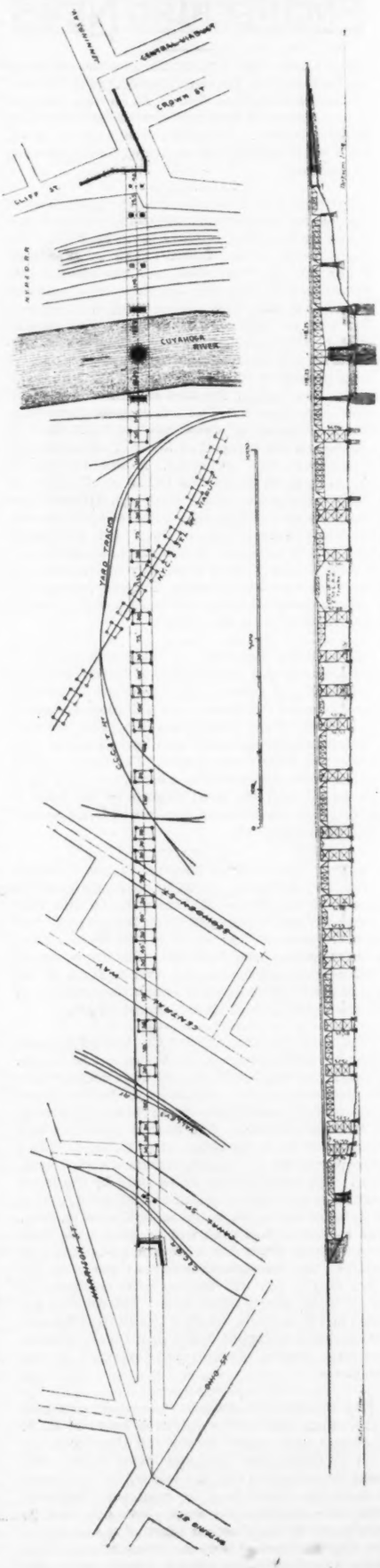
Substructure—Excavation	34,578	cu.	yds.
Dredging	19,546	"	"
Oak, foundation piles.	64,442	l.	ft.
" protection "	17,472	"	"
" cribs	782,891	ft.	B. M.
Pine, in cribs	186,549	"	" "
Iron in foundations	152,000	lbs.	
Concrete	4,584	cu.	yds.
Masonry	17,092	"	"
Superstructure—Iron, (exclusive of hand rail)	4,552	tons.	
" hand rail	265	"	
" in pivot span	554	"	
Pine plank in flooring	817,331	ft.	B. M.
" paving blocks	15,355	sq.	yds.

The following are the principal contracting firms engaged upon the viaduct proper, with the amounts of their contracts;

Stanley Fisher & Co.,	Substructure	$247,528
King Iron Bridge & Man. Co.	Superstructure	200,000
Manley & Cooper,	Hand rail	25,600
W. J. Lindsay & Co.,	Southern pine	25,300
Rieley & Kuentz,	White pine pavement	15,000
Claflen Paving Co.	White pine pavement	5,500
A. Hartzell,	Laying and calking floor	6,000
Thos. Manning, Jr.,	Engine, boiler, pivot machinery, houses, etc.	4,250
Claflin Paving Co.	Street railway rails	4,396
	Engineering and Inspection	20,000
	Total	$675,574

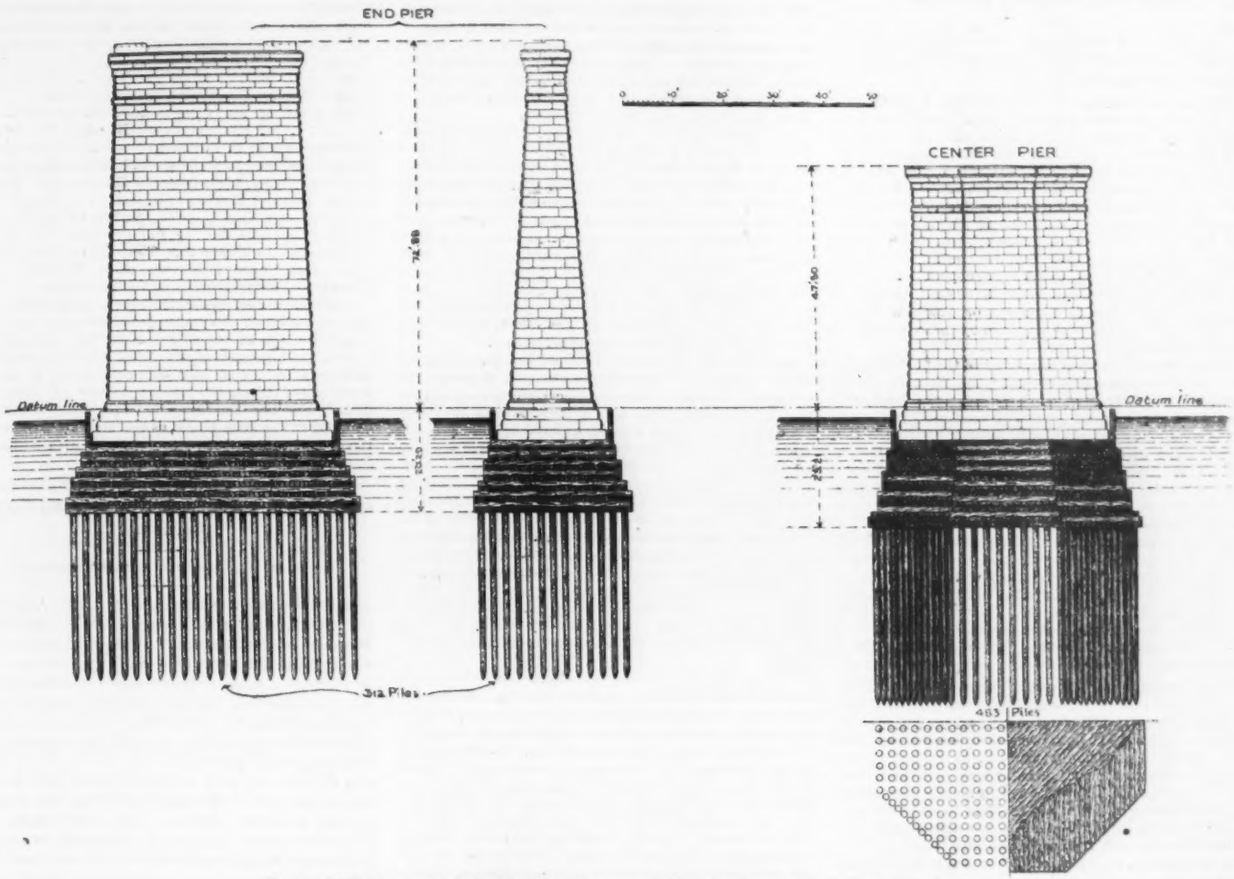
The right-of-way and incidental expenses bring the total cost of the improvement up to about $885,000, a sum well within the $1,000,000 originally appropriated for the viaduct.

This viaduct was commenced under Mr. C. G. FORCE, who was then City Civil Engineer, and the original resolution of councils authorizing this structure stated that it was to be "constructed in general conformity with the plans prepared by City Civil Engineer FORCE, now on file in the office of the City Civil Engineer." Mr. FORCE continued in charge until April 13, 1887, when he was succeeded by the present City Civil Engineer, Mr. WALTER P. RICE, who has just successfully completed this important public improvement. Throughout the entire construction Mr. WILLIAM M. HUGHES has been employed by the Engineering Department of the City of Cleveland as Special Bridge Engineer and Superintendent of Construction, and to his skill and professional and executive ability, very much of the success of this structure must be ascribed.

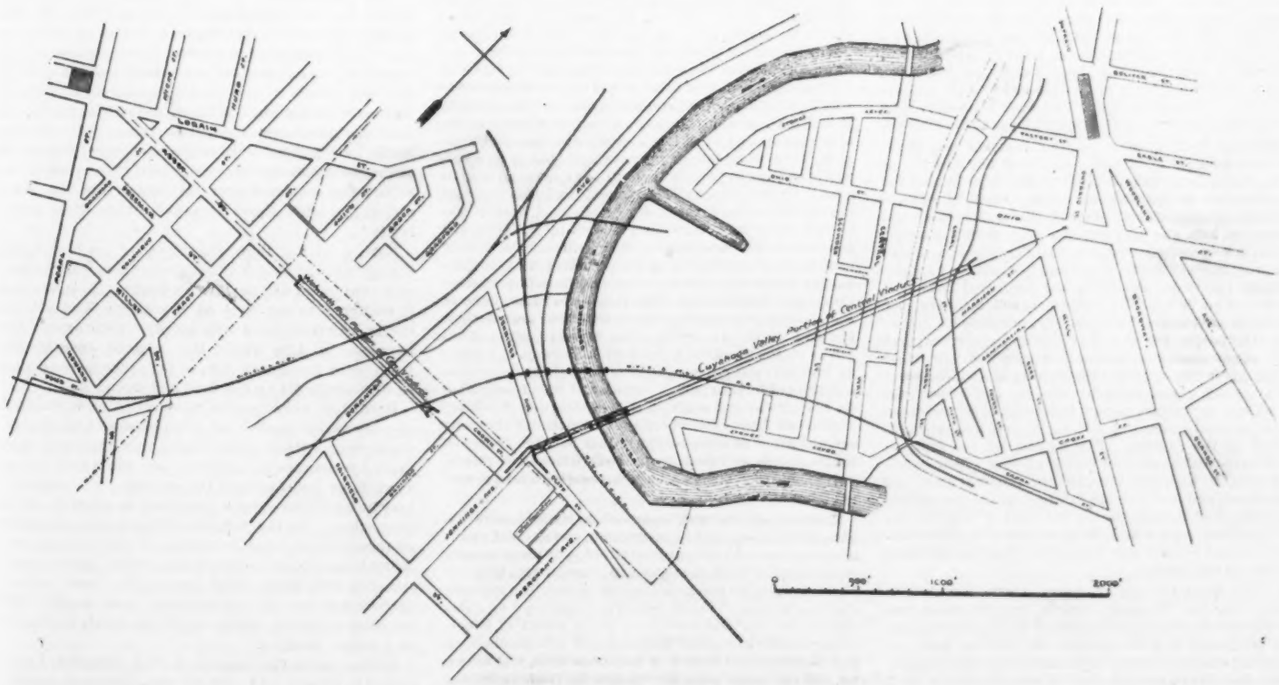


Central Viaduct, Cleveland, O. Plan and Elevation of Cuyahoga Valley Portion.

AN ELECTRIC TRAMWAY is reported as being contracted for in Aukland, New Zealand. The *Colonies and India* says that the builders will be a "well-known Boston firm", and that the cost of electricity will be 14 cts. per mile as contrasted with 21 cts., the present cost for horses.



Central Viaduct, Cleveland, O. River and Pivot Piers, Cuyahoga Crossing.



Central Viaduct, Cleveland, O. General Location.

The First Railway in China.

The following interesting particulars are taken mainly from a despatch in the London *Standard* of Nov. 29, dated at Shanghai, Oct. 19.

The first real railway in China was opened last month (September), between Tientsin, Taku and Tong-shan. Though the length of the line seems small, there being just 86½ miles in all, the success which has been achieved in the matter is a great factor towards future development. It is not the first time that the railway has been seen in these realms; but the short-lived, unfortunate Shanghai-Woosung line, the plant of which now lies at the bottom of the Formosan Channel, into which it was hurled by the fanatic mandarins, was merely a toy to try the Celestial mind upon the graver subject. That line was barely 7 miles long, and would have been regarded by travelers accustomed to European or American trunk lines with scarcely less curiosity than by the superstitious people of Kiangsu Province.

The railway which joins Tientsin and the port of Taku with the great coal region around Tong-shan, where the new Kaiping colliery is situated, is a different matter, and is only the beginning of what will eventually be one of the largest and most profitable railway systems in the world. The official inspection took place on Oct. 9, though the line, with its 28 miles of sidings, had been open to regular passenger and goods traffic for some time before. The object of the journey over the system by the Viceroy and his numerous suite was to report, in a memorial to the Throne, his impressions upon its working; and, judging by his expressions of enthusiastic approval, LI-HUNG-CHANG'S influence will be well worth having by all intending seekers for contracts for railway building throughout the empire. The line has been built entirely by the Chinese, under the superintendence of Mr. C. W. KINDER, C. E., Chief Engineer of the Chi a Railway Co.

There were not many unusual engineering difficulties encountered in its construction, the greatest being the crossing of the river Peh-tang, and in traversing several swampy sections. The land being as flat as Holland, and very subject to floods, provision had to be made for a part of its length to meet the rising waters of the Pei-ho and other streams. This was done by simply raising the line in the most water-threatened places about 8 ft. above the surrounding country. And in one section, that between Peh-tang and Hanku, which suffers frequently from inundation, four fine bridges and a flood-opening had to be provided in a distance of under 8 miles. One of these bridges, which crosses the Peh-tang river, which is here about 200 yds. wide, is a fine specimen of work. It consists of one swing span of 60 ft., ten of 50 ft., and five of 30 ft., in all 730 ft., with iron girders and stone abutments. Altogether this bridge will compare favorably with any in America or England, both for solidity and appearance. Most of the bridges are of the "Warren girder" type. There are many other splendid bridges amongst the fifty along the line; one especially, at a place called Chung-hang-Chang, built in America, and forming a very handsome, light, and strong structure, with a span of 40 yds.; it can be widened by a peculiar arrangement to admit a double line when necessary. The line, is principally single track, with loops at the stations.

Starting from Tientsin, to the first station, Tong-Ku, is a distance of 27 miles, with only one stop; from Tong-Ku to Lutai, 25 miles; and to Tong-shan, where the great works of the Kaiping colliery come in sight, a further distance of about 32 miles. From this place small limestone hills rise up; and the surrounding country, which is wonderfully fertile, is softly undulating. There are great fields of millet, hemp, and flax, and the humbler Chinese vegetables and fruits are cultivated in abundance; not an inch of the rich loamy soil is wasted, and the fields are thronged with thrifty, blue-dressed workers. The people are so prosperous and contented, that they might almost be pardoned if they asked to be let alone, and if they regarded the coming of the iron horse with suspici n and anxiety. So far there has been no serious opposition, except in isolated cases, and these were promptly stamped out by a judicious administration of the bamboo. The owners of the graves—those perpetual stumbling blocks all over China—made some trouble here and there, but the Imperial edict had gone forth, and it was no use fighting against the officials who offered compensation for the right of way for the line, and the people wisely, in most instances, took what they got, and when it was delivered with a bamboo took as little as they could.

A very large amount of heavy traffic has already passed over the Tong-shan branch, and the result has proved that the line was substantially and carefully laid. The permanent way is ballasted with broken stone, in which the sleepers are set. It has been proved by experiment that hard Japanese wooden sleepers wear as well in their natural state here, as creosoted sleepers at home. The rails are well laid and are spiked to the sleepers; the joints being made with English flange fish-plates, bolts and washers. The rails are of steel, of the Sandberg sections, with angle fish-plates, and weigh 70 lbs., 60 lbs. and 45 lbs. according to requirements of the traffic on the different sections. Steel ties are to be tried as an experiment. The Tientsin-Tong-Ku section is of superior construction, steel, iron, and excellent masonry being used in its construction, and the rails weighing 70 lbs. per yard, to meet the requirements of the rapid passenger traffic and the heavy trade in salt and minerals expected. There is little doubt that this branch will be extended to Tungchow, some 60 miles off, and thence to Peking.

The signalling is worked on a very primitive system, but with such a people as the Chinese, who would be likely to mix up more complicated signals, and cause a disaster which might throw back the work of progress indefinitely, it is wise to stick to the old-fashioned simple red and white hand flags, which form the equipment of each signalman. A flag is, however, hoisted on a high flag staff at the stations and dangerous bends. Each single-line section is worked with a train staff. Nor is the management of the points more advanced, the simple hand switch sufficing for the coolie pointsmen, who do their work well, and by-and-bye, no doubt, will be educated to a better and more advanced system.

There are at present only four passenger locomotives on the line, but the number will, ere long, be greatly increased, if the line continues as successfully as it has begun, of which there is no doubt. These engines have four coupled 6 ft. driving wheels, outside cylinders 17x24; 4-wheeled trucks with 36-in. wheels, steel boilers and fireboxes, and weigh 70 tons each, including the tender. Several details of American practice are adopted, including head lights and cow-catchers. The boilers have 212 tubes. The tenders are on two 4-wheeled trucks with 36-in. wheels, and carry 2,300 galls. of water and 2 tons of coal Three came from England, being built by Dübs & Co., Glasgow, and Stewart & Co., of Manchester, and the fourth was built by the Grant Locomotive Works, of Paterson, N. J. Besides these, there are seven tank engines with six 42-in. driving wheels and pony trucks, weighing about 40 tons each, and three smaller tank engines of 12 to 25 tons.

There are two saloon cars for distinguished travelers, in which such modern luxuries as sleeping apartments, lavatories, saloons, and servants' rooms are found, 12 large eight-wheel passenger cars, and half a dozen smaller ones, about 130 coal cars of 10 tons capacity, and about 35 of double that capacity; 60 15-ton stone lorries, and 5 brake vans. The fitting of the ordinary passenger carriages, intended for natives, is not too elaborate; but the passengers have nothing to complain of in regard to comfort, and the fares are low—$1.30 covering the entire journey 86¼ miles in a first-class carriage. The twelve 8-wheel cars have steel underframes, and the coal cars iron underframes. American "bogie" trucks are principally used, but six of the cars are fitted with a flexible wheel base system. The "Janney" coupler is used, and the Westinghouse brake is to be adopted.

The journey generally takes between 4 and 5½ hours, including several short stoppages. This is no criterion of the speed which can be attained when required. On the official trip of the Viceroy, who requested that speed should be slowed down as the train passed interesting points, the rate of 50 miles an hour was kept up for a short distance, between Tong-Ku and Tong-shan, to make up for lost time, and 35 to 40 miles was the average speed at which the train traveled over this section on that occasion; 20 to 25 miles an hour, however, is the rate which is generally kept up, and this to the average slow-moving Chinaman, whose usual rate of progress in a boat or on a barrow is scarcely ever more than 12 li, or 4 miles, an hour, is a truly terrible velocity. The thousands who have utilized the railway, either for curiosity or business, since it was opened, have been immensely struck by its speed, and are described as sitting mute, with open mouths, as they were being whirled along by the barbarian diabolic charger, for which they have since evinced the strongest admiration and wonderment. But they seem to feel none of that fear at their rapid progress which our grandfathers and grandmothers entertained on first entrusting themselves on the Stockton & Darlington Railway. Already an immense and paying goods traffic has been developed, and bales of foreign piece goods may be seen transported on the railway and reaching their destination for distribution in a few hours, where a few months ago they only arrived after as many days' transit in cargo boats, on mules, camels and those quaint and curious conveyances, only seen in China, one-wheeled barrows, with sails to propel them along.

There are several fine, commodious stations, with engine-sheds, in course of construction, at the chief places along the line, and the contrast afforded by the proximity of the signs of Western modern civilization with Oriental barbaric splendor was a curious one indeed. As the train drew up with the Viceroy, who was a passenger on a real railway for the first time in his life, a guard of honor, consisting of the regular Braves, armed with Remingtons and bayonets, and drilled in European style, was drawn up, but they were quite thrown into the shade in martial aspect by the large muster of local militia, each two men with a murderous-looking but warranted harmless gingal between them. Amongst them were a number of heroes dressed in yellow and black striped cotton, which gave them the appearance of tigers, each man being armed with bows and arrows and with grotesque monster heads painted on their shields. At various points along the line brave arrays of gaily dressed troops, horse, foot and artillery, were drawn up, and salutes were fired as the Viceroy passed, and altogeher, it was a most imposing display, the officials of the adjoining districts coming down to the stations in all the bravery of fine colored silks, umbrellas, palanquins, and chair coolies.

The heads of the various departments are all foreigners; C. W. KINDER, C. E., Engineer in Chief and Superintendent; G. D. CHURCHWARD, C. E., Locomotive Superintendent; R. W. LEMMON, Traffic Manager; A. W. H. BELLINGHAM, First Resident Engineer; W. WATSON, Second Resident Engineer; A. COX, T. W. TUCKEY, D. P. RICKETTS, and A. J. E. ARCH, Assistant Engineers. The greatest credit is due to the projectors of the line, amongst whom stands first TONG KING-SING, a man of broad enlightened views; the other directors are WU TING-FANG, WOO NAN-KAO, and WANG KURM.

As a commercial speculation, there is no doubt of the railway's success. Six per cent. has been paid on the first year's working of the older section, that to the Kaiping mines. No argument is so forcible with a Chinaman as a monetary one; and now we may expect to see, ere many years elapse, the real awakening of China. The disturber of her slumbers will be the peaceful but noisy snorting of the Iron Horse, as the long trains wind over the ground which is now encumbered with millions of graves.

Comparison of Formulæ for the Strength of Columns.

BY THOS. H. JOHNSON, C. E., OF PITTSBURG, PA.

IN ENGINEERING NEWS of Oct. 6, Mr. ALFRED D. OTTEWELL, in an article on "Formula for Bridge Members in Compression," deduces an equation for a tangent to the curve of RANKINE'S formula, which he offers as a close approximation, and suggests its use as a substitute for RANKINE'S in practical work. In this article Mr. OTTEWELL conveys the impression that the use of the straight line formulæ was first suggested by himself, and that such formulæ are of necessity only approximations, and not correct exponents of the law governing the behavior of long columns. Both of these impressions I believe to be erroneous: and as the latter impression is shared by many engineers who are and have been using such formulæ, it appears that it should be corrected.

In March 1885, I transmitted to the Am. Soc. C. E. a paper on the "Strength of Columns" read at the Deer Park convention and published in the "Transactions" for 1886.

The preparation of that paper was brought about by the "discussion" called forth by Mr. JAMES CHRISTIE'S experiments, which appeared in the "Transactions" for 1884. That discussion revealed a general lack of confidence, on the part of the best minds in the profession, in RANKINE'S, as well as other formulæ then in use or proposed. Indeed one gentleman seemed to think that all columns were imbued with the spirit of total depravity and were not amenable to any law, "the platted results being scattered over the chart like the stars above, and with about as much, or as little, regularity".

Now, I did not share that lack of confidence, but firmly believed that RANKINE'S formula was the correct expression of the law governing the case: and it occurred to me that as the Milky Way has its limits, and occupies a well marked path across the heavens; so also would the platted experiments manifest a governing law, if only they were enough in number to fill up the field and define its limits.

Published experiments show that in individual specimens, the moduli of compression and of elasticity vary within wide limits, one specimen may show a resistance to crushing one and a half times as great as another, and the modulus of elasticity may be nearly two and a half times as great in one as in another. As the behavior of the column depends on these two physical properties of the material, the possible results of experiments, when platted, may occupy a very broad band across the chart; and a limited number of experiments, may readily fail to indicate the law, which might be clearly indicated by a larger number.

Acting under the suggestion thus afforded, I proceeded to collect and plot all the published experiments on columns, to which I had access. In doing so, I anticipated no other result than a triumphant vindication of RANKINE'S formula. Judge then of my surprise to find that these experiments, so combined into one group, clearly and indisputably show

that the true law does *not* conform to the reversed curve of RANKINE'S formula; but *must* be represented by a *straight line*, within those lengths occurring in ordinary practice; and beyond that *by a curve, to which the straight line is tangent.*

This is the unequivocal lesson of the experiments, of which ocular demonstration may be had by reference to the plates which accompany the paper before mentioned. It may not be disputed, except by discrediting the great mass of published experiments. The nature of the curve, the constants of the formulæ, and other deductions presented in that paper, are my own, and as such are open to discussion and fair criticism. They remain as yet unchallenged.

These deductions were, with notations as below:

1. That the curve is that of EULER'S equation.

$$P = \frac{a\,E\,I}{l^2}$$

which may also be written

$$P = \frac{a\,E\,A}{\left(\frac{l}{r}\right)^2} \qquad (1)$$

or, when $A = 1$, $p = \dfrac{a\,E}{\left(\frac{l}{r}\right)^2}$ (1 a)

2. That the equation of the tangent is

$$p = K - c\frac{l}{r} \qquad (2)$$

3. That from the relations of the curve and its tangent.

$$c = \sqrt{\frac{4}{a\,E}\left(\frac{K}{3}\right)^2} \qquad (3)$$

4. That for the different forms of end bearings

$$\left.\begin{array}{lll} \text{Round Ends} & a = \pi^2 = 9.87 & \text{and } c = 0.6366\sqrt{\frac{1}{E}\left(\frac{K}{3}\right)^2} \\ \text{Hinged} \quad " & a = \frac{1}{2}\pi^2 = 19.45 & \text{and } c = 0.4932\sqrt{\frac{1}{E}\left(\frac{K}{3}\right)^2} \\ \text{Flat} \quad " & a = \frac{8}{3}\pi^2 = 24.67 & \text{and } c = 0.4000\sqrt{\frac{1}{E}\left(\frac{K}{3}\right)^2} \end{array}\right\} \quad (4)$$

5. That the equation for the point of tangency is

$$\frac{l}{r} = \sqrt{\frac{3\,E\,a}{K}} \qquad (5)$$

6. That K is about three-fourths of the ultimate resistance to crushing as found from experiments on short prisms.

The notation is as follows:

P = total pressure on column.
p = pressure per square inch of area.
l = length of column in inches.
A = area of section.
I = moment of inertia of section.
r = radius of gyration of section.
E = modulus of elasticity of material.
K = a modulus of compression of the material.
a and c = constants.

It may be argued that RANKINE'S formula has the weight of "authority", and therefore if a tangent to its curve can be made to fit the experiments equally well, it should be used in preference to EULER'S. To this I reply, that, the formula commonly called by RANKINE'S name, did not have his unqualified support. On p. 360 of his "Applied Mechanics" he says: "There does not yet exist any complete theory of this phenomenon" (the behavior of long columns); and in the same paragraph refers to both GORDON'S and HODGKINS' formulæ as merely "provisional." His own share in the work consisted simply in separating GORDON'S constant into two factors, one of which represents the form of cross-section. On the other hand EULER'S equation has the authority of EULER, WEISBACH, NAVIER, RANKINE himself, and all the lesser luminaries who have followed in his footsteps. None have questioned its correctness for very long columns, though none have fixed the limits within which it may be used. All agree however, that it does not apply within the limits of ordinary practice, where RANKINE'S formula is supposed to represent the law governing the case, and which experiments distinctly and positively disprove.

Let us look at the assumptions on which the two formulæ are based.

EULER assumed that a very long column sustains its load wholly by the elastic reaction of the column in flexure, and hence the resistance to direct compression does not appear as a factor in his equation.

RANKINE'S formula is simply a development from that of GORDON, which rests on the assumption made by TREDGOLD, and adopted by GORDON, that every column requires a certain area to resist the direct compression (constant for all lengths, under the same load, and independent of the form of cross-section) *plus* a certain additional area to resist flexure; this additional area depending on the length and form of cross-section. This assumption cannot be demonstrated, except as the resulting formula is verified by experiments. As the combined experiments disprove the formula, they also disprove the assumption on which it is based.

The correctness of EULER'S assumption may be shown by the following considerations. Conceive a bow, bent and strung, ready for the arrow. The elastic recoil of the bow is resisted by the tension in the string; but the conditions of stress in the bow are those due to flexure alone. If the string be replaced by a pair of external compressive forces, equal to the tension in the string, the stress conditions in the bow will not be altered. The weight of the bow being neglected, these conditions will remain the same whether the plane of the bow be horizontal or vertical; and in the latter case the stress conditions will still remain the same if one of the compressive forces, be an imposed load, and the other, the reaction of a support. We will then have a column supporting its load wholly by its elastic recoil in flexure.

EULER'S assumption is therefore susceptible of demonstration, and his equation must be accepted as the true exposition of the law governing very long columns. Hence it follows that the correct formula for shorter lengths must be one which bears some mathematical relation to EULER'S, and may be transformed into it at that length where the elastic recoil becomes equal to the load; a condition which any formula based on TREDGOLD'S assumption cannot fulfill, and which is fulfilled by the tangent to EULER'S curve.

As the strength of a column depends wholly on the resistance to compression when the length is very short, and wholly on the resistance to flexure when the length is very great, it is evident that the correct formula for intermediate lengths must be one in which the compressive resistance is *not constant*, but diminishes, with increase of length, and eventually becomes zero. This also is incompatible with TREDGOLD'S assumption, and is fully satisfied by the new formula.

A formula meeting this condition will be obtained if we assumed as the fundamental hypothesis, that *a portion of the load is supported by the elastic reaction of the flexure developed by the load, and the residue only produces direct compression.*

This hypothesis is supported by the principle that under specific conditions a given force is capable of producing only a definite amount of work, and no more. From this it follows that if the entire energy is expended in producing compression, there is nothing left to produce flexure; and, conversely, if it is all expended in producing flexure, there can be no direct compression. The old hypothesis considered that the load expended its entire energy in producing compression, and *at the same time*, developed an equal amount of energy in producing flexure. This would require that the sum of all the parts be greater than the whole, and that "once one is two."

A formula founded on the hypothesis herein suggested, must of necessity reduce to EULER'S, when the *residue* producing compression becomes zero, and must also become $P = K\,A$ when the reaction due to flexure becomes zero. That the formula so deduced will be the equation of the tangent to EULER'S curve, the platted experiments leave no room for doubt.

It therefore appears that TREDGOLD'S assumption is fundamentally wrong, and all formulæ based on it must be erroneous. Also, that EULER'S equation is strictly correct for very long columns, and therefore the straight line, indicated by the experiments as representing the law for shorter columns, must be tangent to EULER'S curve and not to RANKINE'S.

Referring to the formulæ given above it will be seen that the net result gained from the platted experiments, is not confined to the simplicity of the straight line formula. The relation which exists between the physical properties of the material, and the constant in the formula, has also been determined, and is represented in equation 3, from which the constant may readily be ascertained for any material whose elementary moduli are known. When these are unknown they may be determined by a few experiments, simple and inexpensive in comparison with the cost of ascertaining the constants for a new material under the old formulæ. This equation comes very apropos just now when steel is coming to the front as a structural material, and engineers are seeking a proper formula for its use in compression members.

I desire particularly to call attention to this equation (3), because many of those who have adopted the straight-line formula, have arbitrarily modified the constant without regard to the relation thus established. Where the variation in the qualities of the material cover such a wide range, it is but natural that men should differ in judgment as to the proper quality admissible in a structure; but the constant used in the formula, should correspond to the physical properties of that grade of metal which it is intended to use in the structure. In a paper recently published, the author used a straight line formula with an arbitrary constant which could only be satisfied when $E = 38{,}500{,}000$, a grade of metal which the gentleman could scarcely hope to obtain, and which he would certainly reject if it was offered.

Equation 5, also contains new matter, and is a contribution to our knowledge of the subject. It fixes the limit below which EULER'S equation ceases to apply, and above which the straight line is no longer accurate. It marks the point where the elastic recoil in flexure is equal to the load, and the compression factor becomes zero. This point is found to occur, in wrought iron at $\frac{l}{r} = 178$ for hinged ends, and 218 for flat ends; and in mild steel at 159 for hinged ends and 195 for flat ends. These lengths are beyond the limits of ordinary practice, so that for every day work the straight line formula only need be considered.

The relation which K in the column formulæ bears to the modulus of compression in short prisms, viz: 75 per cent., may be subject to modification by further research. It is approximately true for the materials embraced in the plotted experiment, and must be held equally true for other materials, until there is evidence to the contrary.

The correctness of any new general law is usually attested by explanations which it affords of other phenomena, not considered in deducing the law; and this case is no exception. Mr. CHRISTIE (p. 264, Trans. Am. Soc. C. E., 1884) pointed out the practical equality of strength of iron, mild steel, and hard steel, when the length exceeds $200\,r$. As heretofore mentioned, the only physical property of the material which enters into EULER'S equation, is the modulus of elasticity, and therefore all materials having the same value of E must be represented by one and the same curve. If, however, they differ in the resistance to compression, they will be represented in the shorter lengths, by different tangents to that one curve. Now, wrought-iron and the several grades of steel, present precisely these conditions. They differ widely in their respective resistances to compression, but have a common modulus of elasticity. Under the new formula they must be represented by converging straight lines tangent to one and the same curve: the last line to join the curve being that of wrought-iron, at the length of $218\,r$, while the line for mild steel becomes tangent at $195\,r$. These figures are for "flat ends," to which Mr. CHRISTIE'S observed length of "about $200\,r$" applies. A more complete agreement between theory and observation could not be desired.

If any reader who doubts the conclusions herein stated, will carefully study the plates which appear in the Transactions of the Am. Soc. C. E., for July, 1886, he cannot fail to be convinced that the older formulæ are all untenable, and that the only true formulæ for columns is the equation of a straight line tangent to EULER'S curve. I trust therefore that those using the straight line formula will do so with a full appreciation of its accuracy and its possibilities; and not in the belief that it is only a labor saving device, which approximates the truth

Charles Francis Adams on the Railway Situation.

At the meeting of the Boston Commercial Club on Dec. 15, President CHARLES FRANCIS ADAMS, of the Union Pacific system, gave an address on the Interstate Commerce law and its workings, which has attracted perhaps even more wide-spread attention than the recent official report of the Commission.

Mr. ADAMS began by saying that while he regarded the Interstate Commerce law as not in all respects wise and beneficent, he did not regard it as the chief cause of the present unsatisfactory condition of the Western railway systems. "In my opinion", said he, "the difficulty is far more deep-seated and radical. In plain words, it does not lie in any act of legislation, State or National; and it does lie in the covetousness, want of good faith, and low moral tone of those in whose hands the management of the railroad system now is. * * * The railroad system of this country, especially the region west of Chicago, is to-day managed on principles which—unless change of heart occurs, and that soon—must inevitably lead to financial disaster of the most serious kind."

Continuing he declared that the Interstate Commerce law had merely operated to make a bad matter worse. Within the past two years there had been a craze for railway construction. Great corporations have contracted the madness and built hundreds of miles of road almost paralleling each other, often across areas on which no human being lived. The construction of this new road made a readjustment of traffic necessary. The problem passed from the engineer to the freight agent. "The dishonest methods of rate cutting, the secret systems of rebates, the indirect and hidden payments made to influence the course of traffic, resorted to or devised during the last two years are unprecedented in the whole bad record of the past." The various schemes for rate cutting and securing traffic were described, and the fact was alluded to that while these things were done, it was almost impossible to prove them in Court.

"It is this absence of good faith which has brought the railroad system to its present low condition, and threatens to carry it still lower. To attribute it to the Interstate Commerce act is an utter mistake. If that act were totally repealed to-morrow, it would produce but a temporary and stock-jobbing relief. The railroad system must heal itself; no act of Congress or repeal of any act of Congress will greatly help it."

"But in saying what I have said I do not mean to imply that in my judgment the Interstate Commerce act is a harmless, much less a useful, piece of legislation. On the contrary, I am very sure that, as it stands, it is not. Both its present effect and its future results are exactly those which its framers never contemplated, and from which, if they realized them as we do, they would recoil. The process of gravitation and consolidation, so far as the railroads are concerned, was going on fast enough before, but the Interstate Commerce act has given to it a new impetus."

The pool as it existed two years ago was a means by which the weaker corporations were kept alive. Its abolition has made the smaller local roads unremunerative and they are thus being forced into the maws of the few great systems. Thus legislation to secure competition is working very rapidly to secure the destruction of all competition.

In a similar way the long and short haul clause was enacted to check the tendency of the railways to build up the great commercial centers at the expense of the small, and it has had just the opposite effect. The old local system of distribution has been broken up in favor of the centralized system, and the law is now working to concentrate the wholesale trade in such centers as Chicago, Cincinnati and St. Louis. Eventually this same tendency will operate to bring it to New York instead of these cities. An artificial but most powerful stimulus has thus been given to the process of centralization. The remedy was a mistaken one. The danger now is that seeing the disease aggravated, the physician may conclude that he has not given enough of his "sure cure" remedy and so proceed to double the dose. It is not another dose of the same treatment, but wholly different treatment, which is required.

"The trend of events seems to me plain enough; nor do I believe that any act of Congress or of State Legislatures can thwart or greatly change it. The railroads of this country are moving rapidly toward some great system of consolidation. I do not know when or how it will come about; nor is it necessary now to consider this. Neither do I believe it will become an evil when it does come. Nevertheless it is a matter of common notoriety that such a result is viewed with grave popular apprehension. We have seen what the progress of the last 20 years has been in this respect. Crystallization has gone on during those years, so that, while then a railroad of 200 or 300 miles was considered large, one of 5,000 or 6,000 miles is now far from being the largest. As I have pointed out, the movement is to-day going forward more rapidly, much more rapidly, under the artificial impetus given to it by the Interstate Commerce act than ever before. The next move will be in the direction of railroad systems of 20,000 miles each, under one common management. The Interstate Commerce act, acting on the tendency of natural forces, is at this moment rapidly driving us forward toward some grand railroad trust scheme. Even this, from my point of view, I cannot regard as a thing to be dreaded. I am very sure now, as I have been for the last 20 years, and as I long ago expressed myself, that a great consolidated corporation, or even trust, can be held to a far stricter responsibility to the law than numerous smaller and conflicting corporations. Under the existing systems no one can be held to account. With one large corporation or trust it would be otherwise. Both law and popular opinion could, and certainly would be directed against it."

While the inevitable result is thus plainly perceptible, the trouble is that it is coming too fast. Neither the public nor the railways are yet educated up to the point where they can enter into so revolutionary a change in the management of our transportation lines without friction. Therefore the provisions of the Interstate law which tend to unduly hasten this end should be amended or repealed.

Mr. ADAMS greatly regretted the public opposition which was manifested toward the proposed Railway Clearing House in the West. Such a scheme would be directly in the line of a strict enforcement of the Interstate Commerce law.

"A reasonable system of railroad rates, publicly announced, equal to all, and honestly maintained, is the commercial need of the day, and not less so for the community of business men than for the railroads themselves."

In behalf of the Union Pacific company, he declared that a strict and rigid enforcement of the Interstate law as it stands would be welcome, in accordance with the aphorism of Gen. GRANT, that the best way to repeal a bad law was to enforce it.

To sum up definitely the proper policy to be pursued: delay the present too rapid tendency towards crystallization and concentration by repealing o modifying those clauses of the law which tend to stimulate it. Let contracts for the division of traffic at reasonable rates be binding in law. Most of all encourage every movement to raise the standard of morality and commercial honor among railway men, such as the plan to take away the rate making power from subordinates and place it in the hands of a legalized clearing house managed by the heads of the companies directly.

The Weather of the United States for the Month of October, 1888.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATIONS.	TEMPERATURE. Degrees Fah.				WIND VELOCITY.			PRECIPITATION. Rain and melt'd snow. Inches.		
					Miles per hour.		Direction at time of Max. Vel.			
	Average	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. rainy days.
NORTHERN CITIES.										
Northfield, Vt	31.3	69.5	—1	70.5	9.6	35	N & NW	3.82	1.00	16
Portland, Me	37.8	66.6	7.0	59.6	9.7	38	N	7.43	1.77	15
New York City	45.2	72.3	18.	54.3	10.8	48	W	4.81	1.53	12
Pittsburg, Pa	44.3	74.3	24.	50.3	4.9	12	S SW & NW	3.57	0.66	19
Chicago, Ill	40.9	75.2	20.	55.2	10.3	38	SW	2.89	1.10	11
Omaha, Neb	36.7	77.6	17.2	60.4	8.5	34	N	0.12	0.06	2
St. Paul, Minn	32.7	65.7	6.	59.7	6.3	24	S	0.34	0.27	4
Duluth, Minn	33.4	57.6	4.5	53.1	6.5	28	NE	0.47	0.42	7
Bismarck, Dak	25.6	59.	zero	59	6.8	48	NW	0.38	0.18	9
Average	36.8	68.6	10.6	58.0	8.2	34.		2.70	0.78	10.6
SOUTHERN CITIES.										
Washington City	46.	75	24	51	5	25	NW	2.97	1.08	10
Louisville, Ky	47.4	78.5	25.	53.5	7.4	25	SW	6.34	2.12	12
St. Louis, Mo	43.6	79.	28.5	50.5	9	33	NW	4.40	1.35	9
Savannah, Ga	56.0	80.8	36.6	44.2	7.7	31	NE	3.74	1.09	14
Leavenworth, Kan	38.2	78.8	22.3	56.5	5.6	30	S	3.50	2.18	9
Jacksonville, Fla	59.5	83.3	38.5	44.8	6.4	26	SE	4.16	1.92	17
Chattanooga, Tenn	50.6	77.6	27	50.6	5.7	28	S	4.64	2.74	9
New Orleans, La	59.1	84.8	41	43.8	8.3	31	S	1.50	0.60	10
Memphis, Tenn	49.0	78	31	47	6	26	W & SW	6.51	2.64	11
Palestine, Tex	63.2	87.1	32	55.1	5.5	22	W	5.92	1.68	14
Average	50.3	80.3	30.6	49.7	6.7	28.5		4.37	1.66	11.5
WESTERN CITIES.										
Helena, Mont	34.2	57	—4	61	3.9	30	SW	0.32	0.12	6
Port Angeles, W. T	40.2	54.9	24	30.9	4.1	23	NE	3.77	1.38	20
San Francisco, Cal	55.1	74.3	47	27.3	5.5	26	SE	3.99	1.68	7
Salt Lake City, U	40.7	63.1	25.7	37.4	3.7	26	S	2.00	1.14	8
Denver, Col	34.4	70.2	11.5	58.7	4.8	32	N	0.33	0.24	6
Yuma, Ariz	60.0	82.5	38.1	44.4	5.3	30	N	0.68	0.3	5
Santa Fe, N.M	35.4	64.1	12	52.1	4.7	26	N & NW	1.30	0.84	8
Average	41.4	66.6	22.0	44.5	4.6	27.4		1.77	0.82	8.6

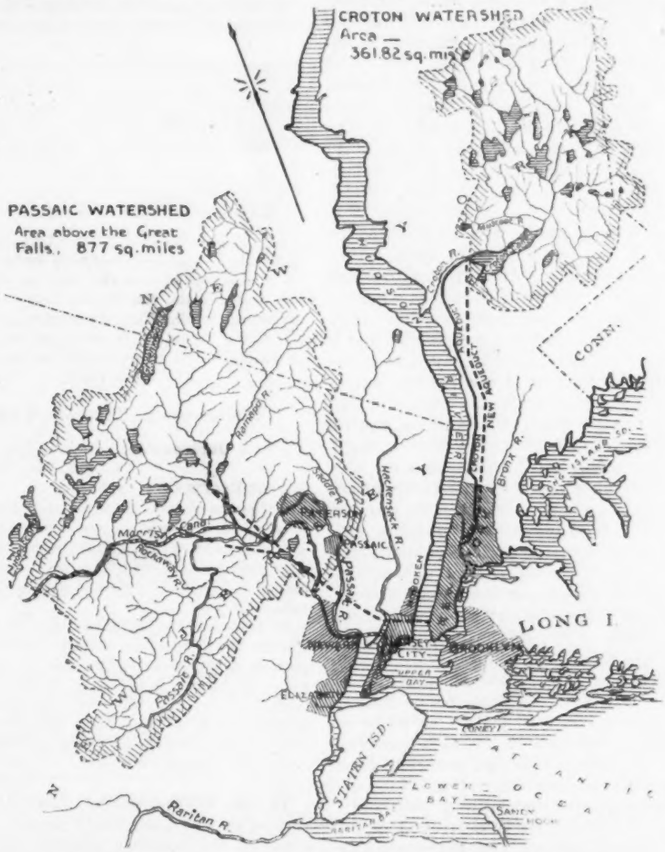
The Bartlett Project for a Water Supply for Lower New York.

This project contemplates bringing 50,000,000 galls. per day of pure water from the Passaic water shed to the lower or business portion of New York, and delivering it under a head of 300 ft. As already noted in this journal, this water will be sold to the city for $75 per million gallons, as stated in the formal proposition made to the Sinking Fund Commissioners on Nov. 30.

The accompanying map outlines the scheme, and contrasts the relative position and areas of the Passaic and Croton water sheds, showing that the former is about 2¼ times as large as the present source of supply and that the storage center is much nearer to the City Hall. But while the Passaic is the largest, all of its water, above the Great Falls, is the property of the Society for Establishing Useful Manufactures, at Paterson; this right is well established by judicial authority and by nearly 100 years uninterrupted use, and the water above that point cannot be diverted for a water supply without the consent of the Society, or by the exercise of the right of eminent domain.

This fact has been considered in the new project, and the right has been secured from the Society and the Dundee Water Power & Land Co., of Passaic City, to utilized the surplus water passing over the dam of the manufacturing companies. As the summer flow is little more than sufficient for the needs of the mills, this condition of the problem made storage reservoirs necessary in the upper Passaic water-shed, from which the flood water could be let down in the natural channel of the river during the dry season. Negotiations were finally closed with the Society giving, as it is claimed, to Mr. BARTLETT and his associates the entire, exclusive and legal control of all the surplus water of the Passaic forever.

The syndicate then proceeded to locate and secure by purchase the available sites for storage reservoirs in the Passaic water-shed. Among the property thus obtained, the pamphlet issued by Mr. BARTLETT mentions the following: Lake Macopin, 2 by ¼ miles in area; 50 ft. to 60 ft. deep; sandy bottom, clean shores and at an elevation of 1000 ft. above tide; it is 40 miles from the city and has a daily output of 9,000,000 galls. of the purest water. Dunker



Proposed Passaic Water Supply for Lower New York, etc.

Pond now has 25 acres of water surface; but a dam 40 ft. high would create a reservoir 4 miles long and one-half to three-quarter miles wide, with 40 ft. of water and an outflow of 16,000,000 galls. per day. Split Rock Lake contains about 250 acres in surface, and has a depth of 10 to 20 ft. of pure water. The Montville reservoir is another secured, along with reservoir sites in other localities.

All of the above are gathering or feeding reservoirs, intended to supply water to the natural channel in the dry season. Distributing reservoirs were the next necessity, and the sites for two of these were purchased. The first is in the Garret Mountain, a spur of the Orange range near Paterson here a dam would form a reservoir of about 300 acres, with 40 ft. of water at an elevation of 400 ft. above tide and distant only 15 miles from lower New York. South of Garret Mountain and contiguous to it lies the Great Notch, forming a natural site for a storage basin with an elevation of 300 ft. above tide. The first of these was set aside for the supply of New York, and the lower reservoir will afford an ample head for the cities of Montclair, Newark, Jersey City and all surrounding towns, if they so elect.

As this source of water supply, as far as New York is concerned, is in a neighboring State with the broad and deep Hudson river intervening, the only serious engineering problem connected with the scheme is the crossing of this river. A number of plans were considered and rejected, and the final decision was arrived at to tunnel the river and carry the water through this tunnel in pipes. Mr. BARTLETT and his associates practically tested the material under the river-bed by furnishing the means for resuming work on the Hudson River tunnel. They had this tunnel pumped out and actually built sufficient new tunnel to convince them that its completion was feasible. The expressed intention is to finish this tunnel for water carriage, and to afford facilities for telegraph and telephone wires; its intended use as a railway tunnel would be abandoned.

To utilize water under 300 ft. head, the Sinking Fund Commissioners would be called upon to exercise the right they now legally have to create an independent system of pipes for fire service exclusively. And for domestic or office purposes the pressure could be reduced to 40 or 50 lbs. per sq. in. and the water used in the present pipe system.

This project, as far as it concerns New York, is endorsed by the Board of Fire Underwriters and by prominent merchants and citizens, and it is backed by the professional opinion of such well known civil engineers as Mr. CLEMENS HERSCHEL, Mr. A. FTELEY and Capt. T. W. SYMONS, U. S. Engineers. The legal side of the question has been reported upon by Messrs. CLARENCE SEWARD and the late ROSCOE CONKLING, who decided that a corporation can be formed which can legally carry out the intentions of this syndicate as hereinbefore expressed.

THE ANGLO-CHILIAN NITRATE & RAILWAY CO., of England, has recently offered for public subscription an issue of $1,000,000 6 per cent. first mortgage bonds. The company has purchased about 9¾ sq. miles of valuable nitrate grounds in the Province of Antofogasta, Chili, about 60 miles from the port of Tocopilla, and has obtained a concession for a railway from the grounds to the port: it is also intended to build a pier at Tocopilla and to lay down water pipes from the Loa river to the port for the supply of the company's works and locomotives, as well as the city and mining companies. Work has been commenced on the railway, and the entire works are to be completed by Dec. 29, 1889. EDWARD WOODS, M. I. C. E., of London, is the engineer of the company.

AN ELECTRIC OMNIBUS is the latest London experiment in traction. It is said to have been successful in its trial trip; is easily steered and runs on a common road, without rails, at a speed greater than that of horses.

DENVER, Col., does not think that Maj. POWELL has done right in removing the branch office of the geological survey to Washington. It thinks that $18,000 out of a total appropriation of $500,000 is not enough for the Rocky Mountain division of the survey.

CORRESPONDENCE.

Strains in Curved Dams.

Cornell University,
ITHACA, N. Y., Dec. 8, 1888.

EDITOR ENGINEERING NEWS:

In case further discussion of the problem of the curved dam may seem desirable, I submit the following:

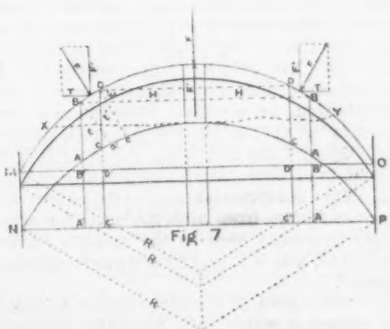
In your recent editorial (Dec. 1, p. 429) my definition of arch action was objected to, and hence I now take up one of your own statements in connection with arch action and make that the basis of another mode of making manifest the inconsistency, or contradiction, which I hold to be involved in the mode of treatment proposed in your issue of Nov. 17.

In your comment on Mr. FLAGG'S communication of Dec. 1, (p. 433) occurs the statement that arch action proper begins "only when gravity stability is on the point of destruction," which I understand to mean that portions of the dam are on the point of sliding on their beds, and actually *do* slide if arch action is called forth to its full extent.

Referring now to Fig. 7, of Nov. 17, you say that the lamina $B\,D\,A\,C$ is in a state of gravity stability; that is, that it is so designed that it cannot slide, nor is it on the point of sliding, in the direction $B\,A$. If such is the case, then a lamina of equal length and of the same shape reaching from B towards H is inevitably possessed of gravity stability also, in the direction $B\,H$, and with greater reason (I assume that the angle between F and F' is less than 45°). Since the whole substance of the portion of dam in the neighborhood of $B\,D$ is made up of similar laminæ, it follows that that portion is in a state of gravity stability: and by symmetry, a similar statement may be made for the other extremity of the line $H\,H$.

But it is claimed that $H\,H$ acts as a strut under the forces $T\,T$. Here is the crucial point. To call forth this strut action considerable "slack" must be taken up between the two ends of the long line of masonry $H\,H$; that is, the two ends move toward each other; and the amount of this motion cannot differ widely from what would occur under arch action. It therefore cannot take place, in other words $H\,H$ cannot act as a strut, unless "gravity stability is on the point of destruction" at the two ends of $H\,H$, which is contrary to the logical result of the first steps indicated above.

Is not this a legitimate *reductio ad absurdum?* It has purposely been expressed in such a way as not to suggest any ideal lamicar subdivision other than that already made by yourself.



Let us now trace a corresponding inconsistency when your theory is applied to a vertical arch ring (or line of voussoirs, call it what you will); and for this vertical arch to be a genuine analogue of the curved dam we must remember that the base of the dam is cemented to the rocky bosom of mother earth, a circumstance which has been largely ignored in the construction of Fig. 11 (of Nov. 17). This proper analogue should consist of a continuous line of voussoirs *cemented to the face of a vertical wall* (behind them in Fig. 11), this wall being fixed

and incapable of contraction. So long as the cement does not give way by shearing action, that element of stability which corresponds to gravity stability in the dam (resistance to slipping on the base; whether we call it frictional or shearing) remains undestroyed. To represent this element of stability in a vertical direction you have inserted in Fig. 11 for each voussoir a vertical strut, (which you should have made very short; for, unless it is *sprung* into place, the vertical resistance of a long strut calls for a sinking of the voussoir, and this cannot occur without yielding of the cement). [This statement is entirely incorrect. The curved rib was not assumed to be an arch or have any arch action whatever, but to be merely a substitute for the horizontal face of Fig. 8.—ED.] This vertical strut I remove, since the analogy of the dam, according to your ideas of treating the latter, requires vertical resistance to be furnished by the cement. Now your horizontal strut is very long (except near the crown, of course) and the development of its compressive resistance demands an amount of horizontal motion of the voussoir that will not be forthcoming unless the cement gives way, that is, unless slipping occurs along the face of wall.

All of which comes to this: Your mode of treatment of the curved dam, when applied to the vertical-arch analogue (the true one) assumes that the horizontal stability of a voussoir depends on an element of resistance which can come into play only by the giving way of the cement *and yet reliance is placed on this very cement to preserve the vertical stability of the voussoir* (corresponding to gravity stability of lamina *BDAC*, in direction *BA*, in Fig. 7).

I cannot but think that Mr. FLAGGS' construction p. 431 of Dec. 31) is also a fair *reductio ad absurdum*. He has carried it just far enough to make a parallel to the idea of reducing the thickness of a curved as compared with that of the straight dam, after the supposed discovery that the toe pressure would be less than in the straight dam if the same thickness were retained on the perpendicular to the chord.

Press of duty at a busy season forbids further detail. With thanks for the space already allotted me, and hoping that bluntness of literary style may not be construed as discourtesy. Sincerely yours,

I. P. CHURCH.

[If Prof. CHURCH considers his first stated "legitimate *reductio ad absurdum*" a sound example of mathematical reasoning, or anything else but a bad *non sequitur*, on seeing it in cold print before him, we shall be greatly surprised. Let us briefly analyze the successive steps of his argument.

1. *H H* "acts as a strut": granted.

2. To so act "considerable slack must be taken up"; granted, substituting "a little" for "considerable".

3. The "*amount* of this slack *cannot* differ widely from what would occur under arch action"; (not granted at all, for it is entirely untrue, the slack being proportional to the pressure, and the pressure being vastly less in magnitude and utterly different in nature and distribution, as we shall shortly show; but whether the amount be great or small, matters little because the following necessary link in the chain of reasoning is omitted altogether:)

4. This compression is *in its nature* the same as results from arch action. (An absolutely necessary step to the validity of the reasoning, which Prof. CHURCH overlooks altogether).

5. "Therefore, *H H* cannot act as a strut," a conclusion which falls with the premises seeking to establish it.

That this strut compression is utterly different in its nature from arch action, should be at once evident from the mere fact that its amount is greatest with small radii, whereas with arch pressures the reverse is the case. The briefest computation will show that it is vastly less in magnitude, while an inspection of the diagram will show that it is different likewise in its direction, and in an unequal distribution through the mass. As one effect of these radical differences, the forces creating the strut action tend to crowd the arch *in* at the haunches (ends) and *up* (outward) at the center; whereas pressure resisted by arch action has the reverse effect.

That it should be necessary thus for a third time to establish a proposition of this nature, again illustrates how difficult it is to get applications of even the simplest engineering principles generally admitted when extended to a new field. To finally close all that we have to say on this question: Assume the entire dam constructed of solid rock, many fold stronger than necessary except for the lamina *BDAC*. Would our correspondent assert that it could not thus be closed by a similar and equal gravity cross-section to that (*B' A'*) required in a straight dam? Yet it is obvious that *BDAC* could not stand a moment, with its oblique face, without the strut action *H H* which our correspondent has endeavored to prove could not occur! Again, arch action from the normal force *F* would throw an equal pressure in each direction, *B* and *D*, whereas the strut action only causes pressure toward *D*.

As for the closing half of our correspondent's letter, may we be permitted to say that it reminds us of the story of the lawyer whose client in jail was giving him his version of the facts in the case? "Why, they can't put you in jail for that," said the lawyer. "D——it, man, they *have* put me in jail" was the answer; and to our correspondent's effort to establish that a dam whose base is "cemented to mother earth" a (fact which he somewhat unfairly says was "largely ignored," as it was distinctly specified several times) cannot act as an arch, we can only reply, on the strength of the Zola and Bear Valley dams, "why, they do act as arches" without any disruption or sliding, in spite of having a gravity stability of nearly 1. Gravity and arch stabilities act together in those structures, and we perceive no reason why they cannot and will not do so likewise with a gravity stability of 2+, although the proportion of arch action will be much less, and "arch action proper" (*i. e.*, that which directly maintains equilibrium) will only begin when gravity equilibrium is destroyed or on the point of destruction. But there was not assumed nor supposed to be any arch action whatever in any one of the Figs. 7 to 11 to which our correspondent refers, giving a "vertical arch analogy", and therefore we cannot admit the correctness or pertinency of any of his statements in regard to those cuts, in the closing half of his letter. In conclusion, we can only cordially echo in our own behalf our correspondent's hope, "that bluntness of literary style may not be construed as discourtesy". ED. ENG. NEWS.]

The Oldest Existing Wooden Bridge.

NEW YORK, Dec. 18, 1888.

EDITOR ENGINEERING NEWS:

Can any of your readers give me information in regard to any existing wooden bridge older than the bridge over the Delaware river at Easton, Pa., built by TIMOTHY PALMER in 1806 and still in use?

THEODORE COOPER.

[We submit this to our readers with the hope that some one will fully answer Mr. COOPER'S interesting query.—ED. ENG. NEWS.]

The Jacksonville, Fla., Artesian Well.

JACKSONVILLE, Fla., Dec. 8, 1888.

EDITOR ENGINEERING NEWS:

Having been very much interested in the accounts of various artesian wells given in your valued paper, I think a description of ours may be of interest to your readers. We have just completed a 10 in. well 700 ft. in depth, which flows by weir measurement 2,000,000 galls. in 24 hours. We have two other 6 in. wells, and the total supply from the three wells is 3,600,000 galls.

The wells are located near together in a triangle whose respective sides are 213 ft., 260 ft. and 330 ft. The static head of the water above the surface is 62 ft. The water is sulphurous, but as the casings are carried up 10 ft. above the ground and the water falls into several basins, and then flows into the pump well with a fall of 6 to 10 ft. it is thoroughly aerated, and all the taste and smell of sulphur is lost.

The water taken direct from the well contains but 22.276 grains of solids to the U. S. gallon. I append analysis made by Prof. LEEDS of Hoboken.

	Grs. per Gall.
Silica and Insoluble Matter	0.729
Alumina	0.047
Carbonate Lime	3.866
Sulphate Lime	4.053
Sulphate Magnesia	2.927
Sulphate Soda	5.843
Chloride Sodium	4.811
	22.276 Grs.
Free Ammonia	0.143
Albuminoid Ammonia	0.004

Hardness, Clarks scale = 4.8 degrees.

By our system of aeration a large amount of the sulphate of magnesia and soda and some carbonate of lime is deposited in the shallow basins in which the water falls, the deposit being cleaned off of them each week. This is proven from the fact that the water taken direct from the wells is a mild cathartic, but after aeration it has no such effect.

Yours truly, R. N. ELLIS.

Double-Gauge Tracks and Switches.

Jacksonville, Tampa & Key-West Ry.

SEVILLE, Fla., Nov. 22, 1888.

EDITOR ENGINEERING NEWS:

Will some of your readers who have had experience in using tracks in common for 3 ft. and 4 ft. 8½ ins. or 4 ft. 9 ins., gauges, either with three or four rails, please communicate with the undersigned? I should be pleased with a sketch of turnout.

By reason of the union of the J. T. & K. W. and Florida Southern roads we must use a considerable portion of the tracks in the Palatka yards in common. Our gauge is 4 ft. 9 ins., theirs 3 ft. I would prefer to use four rails, but can get along with three. I have had but little time to consider the matter, but have yet discovered no plan which does not appear somewhat clumsy. Yours truly,

C. R. KNIGHT.

[If our correspondent finally succeeds in getting up any plan which is *not* "somewhat clumsy" we sincerely trust he will send it to us, as it will be an engineering curiosity; all plans so far developed having been unquestionably clumsy. But unless trains of mixed cars are to be run, we think he will be far better off with three-rail track than four rail. He must then use three frogs instead of one for every head-block, and three crotch-frogs instead of one for every crotch, but he will be better off than with four-rail track still, we imagine, from a considerable experience with the latter. No doubt some of our readers, however, can speak from more extended experience with both three rails and four rails. ED. ENG. NEWS.]

Tables for Setting Slope Stakes.

CANNELTON, W. Va., Oct. 29, 1888.

EDITOR ENGINEERING NEWS:

Enclosed I send you a table for slope-staking which I have found very useful in saving time and preventing errors. The column to the left gives filling in *feet*, headings of colums to the right give *tenths*, and the intersection of foot column and tenth column give required distance from the center line to stake. Similar tables can be made for cuttings of any slope and road-bed. A slope 1 to 1 hardly requires one. Very truly yours,

F. D. HOWELL, Jr.

[A still more useful form of slope-stake table is that printed in red on the back of many metallic tapes, which saves all use of distances out in slope-staking. But if these tapes be not used, a table such as suggested is a great convenience. They are pasted inside the covers of some note-books.—ED. ENG. NEWS.]

Croton Storage.

NEW YORK, Dec. 15, 1888.

EDITOR ENGINEERING NEWS:

Since the critical experts of ENGINEERING NEWS treed me, before I so urgently drew the attention of the Aqueduct Commission to the dangers which threaten Sandy Hook, I respectfully submit a few cocoa-nuts for their diligent study.

Proposition 1. The city of New York when full, will contain about 3,500,000 inhabitants.

2. About 1902, it will require 220,000,000 galls. per day, if the present unreasonable waste is suffered.

3. At that time, with the Muscoot dam and Sodom reservoir, already adopted, it will have, in the city, a storage of 1,311 millions, in the valley 21,911, a total of 23,222 millions.

4. That for a daily supply of one million gallon per square mile per day to the city, a storage of 9,230 billions will provide 100 million gallons per day; 18,460, 200 millions; 27,513, 300 millions; observing that about ¾ of the capacity ratio is needed for dry weather, and ¼ for winter cold snap demand.

5. That in 1880 and 1881, both being low rain years, as reported, a storage of less than 9,000 millions amply covered the supply. That 1880, being, as reported, an entirely anomalous year, with 100 million flow per day, below any other, is not a fair standard of calculation for storage, since the methods of measurement at the dam, are utterly defective, and those reported radically disagree with the monthly rainfall.

6. That at a cost estimated by Mr. CHURCH at about $2,500,000, reservoirs A and D, can be built impounding 14,700 millions, which with those in progress or use will give in the valley 36,600 millions, a storage ample for 300 millions supply per day, which is the reasonable limit of draft from the valley in view of the mean annual flow measured, and the proper use and demands of the valley at that time.

This being the case, neither as a matter of economy nor for storage, is it proper to construct a reservoir at the bottom of the valley to store nearly an equal amount, at a cost of not less than $7,000,000 and possibly even 50 per cent. more.

7. That such a reservoir can then only be filled from the flood wash of the valley—and requires a mean daily flow of 388 millons to do it in a year, and being the receptacle of flood wash, will not be fit to drink, if it can be filled.

8. That the nature of the rock on which its main and sub-dams must be built is so treacherous, and will be so injured in process of construction, that grave doubt must exist as to its successful impound of water, under its enormous pressure.

9. That the present city expense for pumping, public, and especially private, is so enormous, to obtain adequate head, which a distribution head of 115 ft. above tide cannot supply, that a high distribution service of at least 250 ft. above tide, to supply 100 millions per day, is an absolute necessity; that the storage reservoir in the valley will amply control such a service, and to spend a dollar for any new storage below 350 ft. is an engineering blunder, and in view of actual fact, inexcusable.

10. That the city now owns in the valley about 6 square miles of water shed, out of 339; that it is an imperative necessity to control, by purchase and occupation of reservoir sites, and otherwise, as far as practicable, the utmost possible actual control of the surplus rainfall, near where it falls. That if this is not done, the time is not far distant when New York cannot gather 300 million per day from other people's property, who will need it, for their own use or sale, and who will have an inalienable right to its use; and it is therefore utter folly to construct works at the bottom of a stream whose flow is in other hands.

Very respectfully submitted:

SAMUEL MCELROY, Civ. Eng.

[Several of the nuts proposed by our correspondent need cracking badly, and would not be so very hard to crack, but we for the present must decline to attempt to crack them except as to such as can be cracked almost as quickly as they can be "submitted". Neither are we disposed to deny that there is, or once was, a good deal of meat in some of our correspondent's nuts. For example, it may well be questioned whether it was *originally* wise to build the new aqueduct where and as it was built, when by piping from a series of reservoirs at a higher level, a much greater terminal head would have been available. But the aqueduct is now an accomplished fact: and being so, we see nothing in our correspondent's letter to make the opposition to the construction of the Quaker Bridge dam seem less irrational and unwise. Its cost will not be "$7,000,000 and possibly 50 per cent. more"; at least, it should not be. If that be the only objection, a plain rock-fill dam can be built for half the money in half the time and with much more than twice the stability, with the sole disadvantage that there might be considerably more percolation and leakage, which, however, could probably be in time controlled, if not from the first, and could in no case endanger the permanency of the structure. We are not advocating this type of structure for this place; we consider masonry more appropriate; but if cost be the objection, it can in this way be overcome.

That "an entirely anomalous year, below any other, is not a fair standard of calculation for storage" strikes us as a proposition worthy of the Dutch engineer who proposed to average the height of ship masts to get at the clearance of his bridge. Exceptional years is just what should be taken for such a purpose. That purer water than the great Quaker Bridge reservoir will give can be secured by any method whatever, is a proposition so absurd that Mr. MCELROY will find great difficulty in getting any respectable authority but his own for it. That the solid rock foundation is in any sense "treacherous", or that there can be any danger of its failing, seems to us, if possible, a still more absurd claim.

The end of the matter will be that before many years all possible means of storage will be needed and constructed. It is certainly indefensible that there should be so much pumping as is now required in New York, but that is simply because the supply is throttled at the reservoir to prevent its prompt exhaustion. With an *effective* head of 119 ft. at the reservoir, the only pumping that would be necessary would be for a few dozen very high buildings, mostly in lower New York, where the Passaic scheme, described in this issue, may perhaps furnish a needed relief—ED. ENG. NEWS.]

Cement Sewer Pipe.

BROOKLYN, N. Y., Dec. 4, 1888.

EDITOR ENGINEERING NEWS:

In reply to your inquiry concerning "Salt Glazed *vs.* Cement Pipe" we would say that we are manufacturers of Portland cement sewer pipe, which is used exclusively by the city of Brooklyn and in other important systems. We will endeavor to answer the questions contained in the above named article, giving at the same time a short history of our material.

The use of Portland cement pipe in the city of Brooklyn, has proved its durability and its advantages. Some 20 odd years ago, that distinguished and most honorable engineer, MOSES LANE, saw the necessity of making the sewer pipe so that it might be laid with greater security against settlement, and with a shape better adapted for self-cleansing. The round, flat-bottom, 12-in. pipe and the egg-shaped 15-in. and 18-in. pipe with flat bottoms were adopted. The Brooklyn pipe sewers are laid on a *plank*, thereby securing a perfect gradient, and a uniform bearing. The joints are thoroughly made, and the inside of the pipe sewers is as true as a cannon barrel. The ordinary flow in the street sewers is very small compared to the size necessary for a rain system, and the deep flow which is given by the egg-shape is an important advantage in its scouring effect. The pipes are 3 ft. long, and, therefore, have fewer joints and less chance for leakage than in the case of the 2-ft. stoneware pipe generally made.

Lately, the American manufacturers of the stoneware pipe have tried the longer pipe, but they warp and are very untrue. Our 24-in. egg shape pipe, are just as true as the smallest pipe made.

Engineers frequently go so far as to say that cement as a material is unfit for such use. But these opinions are inconsistent with facts. The engineer has always depended upon Portland cement for his most durable works, and eminent engineers do not hesitate to build concrete sewers in trenches. How can they then object to the use of this material, when properly used in pipes?

We acknowledge that there has been much bad cement pipe made and put upon the market, but this fact does not condemn the pipe, it merely condemns the individual makers. The claim is made that the cement pipe furnished for Brooklyn, is superior to any glazed pipe manufactured, and any engineer is challenged to point to a failure in that city since the use of cement pipe. It is true that the engineers here know what a good cement pipe is, and have by their honest inspection kept the standard up to the highest mark, but other engineers should be able to do the same thing. Samples of our cement pipe, dug up from time to time, show no signs of decay and are apparently in a better condition for their years of use.

Portland cement is composed of a large portion of lime, carbon and oxygen. In the process of manufacture the heat causes the lime and oxygen to unite, and the carbon is expelled in the form of carbonic acid gas. The cement is then much lighter, and has a greater affinity for water and the gas which it has lost. This is practically the same kind of gas generated in a sewer; moisture favors the reunion. This explains why an old cement pipe is less porous, and is heavier and harder than when first made, the carbonic acid gas has been reabsorbed, and changed to the solid form.

By permission of Mr. ROBERT VAN BUREN, Chief Engineer of the City of Brooklyn for the last 12 years, it can be said that the entire pipe sewer system of that city is constructed of cement pipe, and has proven entirely satisfactory, and in quality and shape they are all that is claimed. Under Mr. VAN BUREN the pipes are subjected to a rigid inspection, each piece being carefully tested before being laid, which is to the credit of goods having the preference over other material under those conditions. Portland cement is used exclusively in their manufacture.

The following letter or report by Mr. J. W. ADAMS, the well known engineer, is added in corroboration of what otherwise might seem an *ex parte* statement only:

Department of City Works.
BROOKLYN, N. Y., Mar. 25, 1873.

This department took up a cement pipe that had been laid in Fleet St. in the year 1861, and the pipe was found in every particular as good as when laid. A section of this pipe is preserved for inspection. This department has nothing to do with any particular concern, or with the purchase of any materials used in the construction of the sewers. Under the contracts the contractor furnishes all the pipe, brick, etc., subject of course to the inspection of the Department, and nothing but good material is allowed to be used. The cement pipe furnished by Knight & Wilson, the original manufacturers, are second to none made in the country. Many of the American stoneware pipe are neither regular in section or well burnt. This regularity is a prime necessity to prevent deposit, and is readily obtained in a cement pipe but rarely in a burnt pipe. Resp'y submitted,

J. W. ADAMS, Chief Engineer.

We submit the above hastily collected matter, and if any more points present themselves to be covered will be pleased to reply.

Yours respectfully,
THE WILSON & BAILLIE Mfg. Co.,
E. H. BAILLIE, Sec.

[While the general purport of this letter is such as to hardly admit it to our correspondence columns, the information contained is directly in the line of the queries put to us by other correspondents, and it is consequently useful. The standing of the above firm as manufacturers, and their long practical experience give weight to the statements made.—ED. ENG. NEWS.]

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL

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D. McN. STAUFFER, A. M. WELLINGTON.
EDITORS.
GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription.—UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $6.56 *per Year, or 3 cents per number additional.*

Coming Technical Meetings.

American Society of Civil Engineers, New York.—Regular meeting, Jan. 2. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, Jan. 2. "Interlocking System of the St. Louis Bridge & Tunnel Railway", A. W. Hayes; "New Power Drill for Quarries and Mines, with Notes on Mining in Colorado", J. A. Ockerson. Secy., Wm. H. Bryan, 709 Market St.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Jan. 2. Secy., L. E. Cooley, 171 La Salle St.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Jan. 5. Secy. Howard Murphy, 1122 Girard St.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting, Jan. 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Jan. 7. Secy., Kenneth Allen, Y.M.C.A. Building.

Civil Engineers' Club of Cleveland, O.—Regular meeting Jan. 8. Report on Architecture. Secy., James Ritchie, Case Library Room.

New England Railway Club, Boston, Mass.—Regular meeting, Jan. 9. Boston & Albany passenger station.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Jan. 15. Secy., S. M. Wickersham.

New York Railway Club.—Next meeting Jan. 17. Rooms 113 Liberty St., New York City.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Jan. 19. Secy., S. E. Tinkham, City Hall.

THE hearing of testimony against the construction of the Quaker Bridge dam in any form continues, indicating the existence of a strong if not very numerous opposition, but bringing out little that is new. We should be inclined to greater faith in the sincerity of this opposition if it were not so extravagant and sweeping; reminding one a little of the mythical defendant who alleged 1, that he had not borrowed any pot; 2, that it was whole when he returned it; 3, that it was cracked when he borrowed it. The onus of the opposition is; 1, that there is no need of a dam at all; 2. that the dam will not stand if it is built: 3, that it will not hold water if it stands; 4, that the water will not be fit to drink if it is held; 5, that the dam cannot be made not tohold the water if it is bad. There is, to be sure, more of a logical sequence in these arguments than in the pot litigation: but if any one of these propositions is true, why take so much trouble to establish the other? The only one of these claims which seems to have any possible rational basis is the first; but it destroys all one's faith in the sincerity with which it is urged, to find that the four remaining claims, all of which seem clearly untenable, are urged with even greater vehemence. Thus, Prof. REMSEN, of Johns Hopkins University, testifies to his having discovered the fresh-water sponge growing in two or three shallow reservoirs, and to the fact that it might grow in the Quaker Bridge reservoir. The fact that there are several thousand shallow reservoirs in the United States, however, in which this obnoxious plant has not grown, including all those of the present Croton system, and the fact that, if there really seemed cause to fear trouble from this source a slight modification of plan would permit of draining the new reservoir to the bottom, rather diminishes the force of this objection; while the attacks upon the probable stability of the dam have even less solid basis of fact in their favor. We have always believed and stated that the original design for the dam had too small and too irregular a factor of safety for prudence; but this design has now been modified, and may be modified still further before the dam is constructed.

THE project for supplying the "dry-goods district" of New York with water under heavy pressure, elsewhere described, is plausible and as a business enterprise is apparently sound and well endorsed. The key to the problem, and the only feature of considerable engineering importance embodied in it, is the crossing of the Hudson river by completing the Hudson river tunnel; and in connection with this crossing we are by no means as sanguine as are Mr. BARTLETT and his associates. This tunnel is not yet "the substantial fact" claimed. It is just possible that contingencies of water under land pressure may yet be met with in that "bore" that will render the "horizontal compressed air process" useless as a means of progress; and while the freezing process, or something akin to it, may be successful, the promoters must be prepared in that case for an extremely heavy outlay of capital, or to abandon the work with all it has cost to that point. It is yet one of those hazardous enterprises that everyone would like to see pushed to some definite ending, in the interest of a better crossing of the wide and troublesome Hudson river, but everyone also wants to see it pushed with some other body's money.

ON the other hand there can be no doubt that a water-supply under the promised pressure is badly needed in the lower end of New York, and a pressure of equal head can not be obtained from the Croton Aqueduct even when completed in all its details. But if it is fire pressure alone that is wanted, a cheaper plan for the city and one quite as effective could be found in the several times proposed direct pumpage and stand-pipe scheme, with the North or East rivers as a source of supply. If the Commissioners of the Sinking Fund are supposed to lay a system of heavy mains, "for fire purposes exclusively," for the Passaic water, it would cost no more to do it for the river water that passes by our wharves, and the water of one is quite as good as that of the other for the purpose intended. This same river water would answer equally well for street sprinkling, sewer flushing and a number of other purposes for which potable water is now used. The expense of maintaining the pumping plant or plants would be offset by the saving in fire engines and the better protection of property. And the potable water saved would go far towards increasing the domestic pressure on the mains now existing, or on larger direct mains from the Central Park Reservoir leading to the high buildings down town. The BARTLETT project seems a good one for the Jersey cities and towns that can not or will not supply themselves with good water; but for the better protection of lower New York, the main argument of its advocates, there would appear to be alternative schemes that would answer equally good purposes and yet remain in the hands of the city that has the most interest in it and should properly control its own public works.

As a means of supplying a badly needed commodity to Jersey City, Newark, Montclair and smaller New Jersey cities and towns, this project has much to commend it. The fact that all of these towns need water badly, and must practically look to a common source for this supply, loudly calls for concerted action on their part; for the reason that a common gathering plant and, to a considerable extent, one distributing reservoir and distributing main, would serve them all, and the expense of a separate and independent system for each town is so great as to be almost prohibitory. For reasons not here necessary to state, this concerted action as corporations seems to be impossible of realization; though the citizens of both Jersey City and Newark now take sewage-contaminated water from this same Passaic river, and are clamorous for a better supply, with seemingly little hope of immediate relief from a public source. Carried out upon a sound and just business basis with its affairs intelligently and honestly administered, as we believe is the intention of Mr. BARTLETT and his associates, their scheme certainly has in it an element of economy that should be carefully considered by those very cities which now so vigorously repel it. This water-furnishing syndicate seems to legally and exclusively control the most available water shed for supplying these towns; and if it can maintain this claim or acquired right, it is difficult to see what the towns in question are going to do about it; the right of eminent domain alone can dispossess them. The syndicate has done the very thing the towns should long ago have done for themselves; and if there are some disadvantages in the present proposals for a private supply, the towns and not the syndicate should be blamed. In fact, these cities, acting together, might have had not only pure water enough for their own use, but have made their own works self-sustaining by selling the surplus to New York or Brooklyn, as is now proposed by others.

FROM all knowledge which outsiders can gain, it would seem that the action of the Baltimore & Ohio stockholders in removing Mr. SAMUEL SPENCER from the Presidency of that company and electing Mr. CHAS. F. MAYER in his stead was a move against their own best interests. The former has a well earned reputation as a railway manager, which has lost nothing by his year's work at the head of the B. & O. The recent annual report, while it ruthlessly cut down the famous "surplus fund" and was made up in general contrary to all the precedents established by the reports which were issued in the GARRETT days, showed the results of a year of faithful work and received its best compliment in the advance which it caused in the company's stock. The commendable tendency of the present time is to place men thoroughly trained in railway management rather than bankers at the head of our great systems. However eminent a financier and business man the new President of the B. & O. maybe, he will have no easy task to improve on the record made by his predecessor. There is, however, a chance for anyone with sufficient skill and foresight to make the B. & O. a greater property than it is by securing for it a greater share of trunk line business. It has never had the share which it is geographically entitled to, and the property as a whole has suffered in consequence; although doubtless not so much as it might have suffered by entering into a reckless scramble for it. The last it has conservatively avoided, but in so doing it has allowed itself to be somewhat out generaled, and cut off from natural sources of traffic.

THE Panama bubble has burst as gently as a bubble should, without any of the predicted disastrous consequences to the French Government and financial world, so far as has yet developed. Its end was like its beginning; gush and humbug to the last. Much may be pardoned to M. DE LESSEPS' age, but his getting up within a few hours of the final confession of bankruptcy to declare that "the canal was made" and "its enemies confounded" was at least maintaining a consistent attitude to the

last, and sheds a curious light on the sincerity and good faith of the similar declarations with which the world has been favored for three or four years past. There is not, in our judgment, the least probability that anything more will be done to complete the canal for 20 years to come. The strongest anxiety at present seems to be to let the bondholders down easy. This will prevent the early inception of the only measure which could be effective for completing the work; viz., to wipe out completely all past obligations, beyond the payment of a few millions of new stock for plant on hand, and to thus start in with a clean slate, to raise and spend the $200,000,000 or so which are still necessary to put the canal in effective operation. No investor in his senses will think of contributing these necessary funds unless he is to enjoy the profits of the enterprise complete as well as share its risks, if indeed he will think of it at all; but such radical measures the present bondholders are not likely to submit to without a long struggle. They will rather continue to hope against hope that the Government or private parties will consent to take all remaining risk of the enterprise for a possible 10 per cent. or so on their investment, passing over to the old investors all remaining profits. Except that the United States Government stands in the way, the French Government might probably be persuaded to do this; but as their financial difficulties are great and the hostility of our Government certain, they will hardly attempt it.

In the face of this fiasco, how amazing appears the cheerful self-confidence with which it was started in to build a *sea-level* canal for $120,000,000 in 6 or 8 years, and which it was declared in 1886 after 5 years work on it, and over $100,000,000 expenditure, would still be finished to sea level for the originally estimated sum! Nothing in the whole history of the French people has so tended to make them ridiculous industrially as the strange story of this enterprise; it was begun without knowledge; it was prosecuted without judgment; it has ended without honor, either to the dupes who paid the money, or to the enthusiasts and rascals who received and spent it; spent it so recklessly that, as we very recently showed (Dec. 8), they did not even stop to make their statements of what they had done with money spent agree with each other in the same lines of the same page, in the very document put out to ask for more to spend! Had it been merely a small private enterprise of a few millions only, the facts would have been surprising enough; but it was one of world-wide importance, which the whole world has been watching and talking of, in which every ninth family in France had invested savings; yet with one or two exceptions the whole French press and the whole French official class has been dumb as oysters about the actual status, clear to all the world beside! Can any one believe that an American or English enterprise could have thus defied the opinion of mankind and deceived its stockholders even for a year? It would have been quite out of the question. Daylight would have been let in upon its status and prospects; and its stockholders might have lost their first investment, but would speedily have seen through the situation, and at least not have continued for a decade to send good money after bad.

An arraignment of a whole people is proverbially difficult and apt to be unfair; but if ever there was a case where the bare facts seemed an arraignment, it is the case of the Panama Canal Co. Many hundreds of Frenchmen, and not DE LESSEPS alone, have been prominently connected with it in one capacity or another, in positions where they had opportunity to form a correct idea of its real progress and prospects; yet as respects the sea-level feature at least, there is no one of them who can escape the charge of having stood by and seen hundreds of thousands of his trusting countrymen grossly swindled and deceived, except by confessing that he was incapable of seeing facts which the competent engineers and contractors of the rest of the world saw almost from the first, and pointed out in print again and again. It is earnestly to be hoped that the failure at Panama will not throw such discredit on the Nicaragua project as to prevent that likewise from going forward to completion. It does not seem likely to us that it will do so, but rather, that the collapse at Panama will bring the Nicaragua project into increasing favor. In one important respect its management has been directly opposite to that at Panama; it has been careful to find out just what had to be done before it set out to do it. It has done this very effectually, as we shall shortly show by a detailed profile; and matured a project so excellent that had it been presented in its present shape at the "International Congress" of 1879, packed as it undoubtedly was in favor of Panama, we do not believe that even M. DE LESSEPS strong prejudice in favor of a sea-level canal would have held out against it, and in that case the Nicaragua canal would probably be to-day an accomplished fact, and the name of LESSEPS crowned with a double honor which would have made him famous for all time as a benefactor of mankind.

The Railways and the Public.

The vigorous statement of the present situation of the Western railway systems, made by Mr. CHARLES FRANCIS ADAMS, which we abstract in another column, sums up tersely the present status and tendencies of railway management and the causes of present crying evils, and well deserves the attention it has received. Hardly a man in this country is so well fitted to give a candid judgment upon the vital problem of the regulation of railways by the State as Mr. ADAMS; and the main criticisms which have been made of his statements arise from the fact that a few railway men are vexed because he did not give the Interstate Commerce law the wholesale condemnation which they would have wished; while the public, as represented by the newspapers, is afraid of any proposition to restrict competition among the railways, and takes fright without reason at the words "Monopoly" and "Trust."

But in two important points, at least, the statements of Mr. ADAMS' address seem open to question. We are loth to believe, in the first place, that the character of our railway managers is deserving of any such unsparing condemnation as Mr. ADAMS visits upon it, or as the Interstate Commission gave it in its recent report. At least, it is difficult to see what is to be gained by putting the case in that light, for the evidence all seems to show that it is the higher officials and not the subordinate traffic agents who are responsible for the evils of rate cutting in its various forms, and that in the last analysis it is the *system* and not the *men* which deserves the blame and needs the remedy.

The statement that the enforcement of the long and short haul clause works in the end to stimulate the growth of the greater commercial centers and retard that of the smaller, more than did the old system of direct discrimination against all non-competing centers, certainly demands much fuller proof before it can be accepted. So far as we recall, Mr. ADAMS is the first to discover this tendency, and if it be a fact that it exists, it is important that it should be backed up by thorough proof.

In the main statements of his address, however, Mr. ADAMS is to be heartily endorsed. It is undeniably true that the railways of the country are sooner or later to be merged in a very few great systems, between which and the parts of which there will be little or no competition; whose rates of transportation will be public, stable and subject to regulation by Government. It is absolutely plain to candid students of the subject, that much as we may deprecate the interference of the Government with the affairs of commerce, this solution of the railway problem is the one which the logic of events is forcing upon us.

But to change our present complex and contradictory systems under which the joint functions of the Government and the common carriers are exercised, is a work that needs much time to accomplish safely. The rights of railway owners, railway patrons, and the different competing commercial centers have all to be considered, and equitably adjusted. It is not a work which the wisdom of our legislators is likely to effect and effect well in any short time; and if the course of events, such as the formation of far greater railway systems before public opinion is prepared for it, forces legislation inimical to the railways, as is to be feared, the result may be financial disaster of unparalleled magnitude.

It is for this reason, as we understand, that Mr. ADAMS wisely advocates the conservative course; legislation to restrict rather than stimulate competition. The attempt to educate public opinion up to the fact that competition among railways can be legally restricted without infringing the rights of the public is one which must be persevered in. This done, the way to the practical accomplishment of "the unity of railroad interests" will be a direct one.

It is encouraging to note that considerable progress in this direction has already been made. The newspaper press, which so closely reflects and guides public sentiment, has reached an understanding of the fact that railway owners as well as shippers have undoubted rights; and it is now quite generally said that "pooling, if it is necessary, should be regulated by Government," which is exactly what the railways desire. Two years ago the admission that agreements by the railways in restriction of competition might justly be legalized, was hardly heard.

It is gradually coming to be understood, however, that with the power of both State and Nation exercised to regulate both the facilities which a railway must offer to the public and the rates which it must charge for transportation, competition is not the essential factor in the control of the business of common carriers that it is in other commercial affairs. Railway consolidations are not fought so bitterly as in former days, and the fact that owners of railway property as much as owners of other property, are entitled to Government protection is better understood.

While the public is learning these lessons, it would seem good policy for those at the head of the Western railway systems to reflect upon a motto famous in American history:—"We must all hang together, or we shall all hang separately." There is also much for them to ponder over in the section of the report of the Interstate Commerce Commission headed, "The Unity of Railroad Interests." The pooling of earnings, which is so eagerly clamored for, was after all but a device to make each company financially responsible for its traffic contracts. If the same agreements that were made under the pool were made and *kept* today, Western railway properties would re-

cover their position as rapidly as they have lost it. Surely the charge so often heard that some of those at the head of the Western systems are more interested in speculative manipulations of their company's stock than they are in earning dividends for their stockholders, cannot be true. If there is such a board of managers, or if there be one unwilling to cooperate with their competitors in bringing rates back to a paying basis, they deserve the personal condemnation of those with whom they should work in harmony, and should receive from their stockholders at an early day the reward due to their achievements.

The Water-Works of the Middle States.

II.

RESERVOIR CAPACITY.

We conclude our review of last week by adding a few tables and notes which we did not then have room to insert. Table 17-B gives the facts in regard to reservoir and daily consumption for 76 water-works, including most of the more important ones. We may note here that we are obliged to omit for this year and next any tabulation of the consumption of water per inhabitant for the reason that the actual size of the population supplied is so uncertain, the last authentic statistics being for 1880 in most cases, or 8 years old.

The reservoir capacity in days' supply, given in the last column, shows naturally a very wide range from less than a day's to a year's supply. A large part of this variation is perfectly natural and proper, since it depends on the abundance of the supply relatively to the demand. The supply of a great city from a small river, as at New York, naturally demands great storage capacity, which is soon to be made much greater. The reverse conditions naturally require but little reservoir capacity. The total storage capacity of a most of the larger systems is given in Table 17-B.

TABLE 17-B.

MIDDLE STATES WATER-WORKS.—RELATIVE RESERVOIR CAPACITY AND CONSUMPTION OF 66 WORKS.

(Including the more important or significant works only.)

Water-works.	Storage capacity. Millions of gallons.	Daily consumption. Millions of gallons.	Days supply stored.
NEW YORK			
Albany	216.7	9.0	24.1
Amsterdam	90.0	.166	54.0
Attica	12.0	.225	53.3
Brooklyn	1,180.0	46.27	25.5
Cambridge	7.0	.004	175.
Chatham	1.5	.15	10.0
Cohoes	92.0	3.0	30.7
Fonda	2.0	0.1	20.0
Fredonia	8.0	0.05	160.
Gloversville	15.0	0.5	30.0
Goshen	46.0	0.25	184.0
Hornellsville	50.0	0.8	62.5
Hudson	3.2	1.3	2.5
Johnston	10.0	0.5	20.0
Little Falls	26.0	4.0	6.5
Middletown	300.0	0.9	333.
Newburgh	2.0	2.0	1.0
New York	18,325.	110.0	166.6
Peekskill	37.0	0.28	132.
Port Jervis	275.0	1.0	275.
Richfield Springs	9.0	0.5	18.0
Rochester	65.6	7.2	9.1
Sherburne	10.0	0.03	333.3
Syracuse	80.0	6.0	13.3
Troy	531.0	8.0	66.5
Utica	800.0	3.0	266.7
Watertown	3.25	2.0	1.6
Waverly	58.0	0.5	116.
Yonkers	00.	1.57	254.
NEW JERSEY			
Camden	7.5	5.3	1.4
Gloucester City	2.0	.075	2.7
Jersey City	237.0	16.5	14.4
Lambertville	22.0	0.25	88.
Morristown	16.0	.275	58.2
Mt. Holly	0.6	0.2	3.0
Newark	46.0	12.6	46.5
New Brunswick	15.0	1.08	13.9
Orange	375.0	1.0	375.
Paterson	50.0	8.0	6.2
Perth Amboy	20.0	0.35	57.0
PENNSYLVANIA			
Allegheny	18.0	17.8	1.0
Allentown	.41	2.0	0.2
Altoona	63.0	.175	359.
Ashland	3.8	.35	10.9
Beaver Falls	3.0	2.5	1.2
Bellefonte	.29	.30	1.0
Blairsville	.20	.16	1.2
Bradford	24.0	1.12	21.4
Conshohocken	1.25	.175	7.3
Easton	5.0	1.5	3.3
Erie	30.0	3.34	9.0
Franklin	17.0	0.80	21.2
Harrisburg	20.0	6.4	3.1
Lancaster	6.0	4.0	1.5
McKeesport	6.0	1.1	5.5
Meadville	5.0	1.0	5.0
New Bethlehem	1.28	.15	8.5
Philadelphia	373.0	88.85	4.2
Phœnixville	2.52	0.5	5.0
Pittsburgh	120.0	30.0	4.0
Pittston	2.5	1.1	2.3
Plymouth	9.3	0.6	15.5
Pottsville	450.0	1.5	300.0
Reading	154.2	4.0	38.5
Sayre	3.0	0.4	7.5
Scranton	80.0	5.0	16.0
Shamokin	41.0	1.0	41.0
Sunbury	4.7	0.4	11.8
Wilkesbarre	3.25	48.0	14.8
York	0.6	11.0	18.3
DELAWARE			
Newcastle	1.25	.45	2.8
Wilmington	41.6	5.3	7.8
MARYLAND			
Baltimore	983.0	34.0	29.2
Hagerstown	20.0	0.5	40.0
Union Bridge	.425	.04	10.6
Westminster	1.0	.01	100.0

The large reservoir capacities of the New York works as a whole as compared with Pennsylvania is notable. Nearly all the Pennsylvania works have but a few days' supply; most of the New York works, many days' supply.

DAMS.

The highest and most important water-works dam in the Middle States, and so far as we now know east of the Rocky Mountains, is the Druid Lake dam, of the Baltimore water-works. This dam is of earth, 119 ft. high, with a puddle heart-wall, 36 ft. thick at the bottom, extending down to rock 12 ft. below the surface. On the bed-rock a small rubble wall, 5 ft. high by 2 to 4 ft. wide is built to check percolation. The dam is a long one and has been an entire success. As the details are given quite fully in our account of the Baltimore works, we will not rehearse them now.

In all we have details of the following earth dams, omitting some of trifling importance:

New York, 28 earth dams, ranging in height from 12 to 60 ft., the majority of them above 35 ft. and built in most cases, unlike the New England dams, with puddle heart-walls. In New England, masonry heart-walls are almost universal; but we have no record of the failure of any of the New York puddle dams. The usual inside slopes are 2 to 2½ to 1, and outside, 1½ to 2 to 1. They are mostly quite short; under 500 ft.

New Jersey, 3 earth dams, the largest at Orange, 40 ft. high by 875 ft. long on top.

Pennsylvania, 15 dams (including 1 small rock-fill dam, backed with clay) the largest being that at Pottsville, 35 ft. high by 1,350 ft. long, 40 ft. wide on top, with 2 to 1 and 2½ to 1 slopes.

Maryland, (none in Delaware) the great Druid Lake dam above described and one other at Hagerstown.

The most important stone dam as yet existing is the Boyd's Corners dam of the Croton works, 78 ft. high. The main Croton dam (the first one of which was carried out under interesting circumstances which we will not repeat) is 40 ft. high. We have records of only 5 other masonry dams in New York, the highest 25 ft. high.

In New Jersey the only stone water-works dam is that at New Brunswick, 15 ft. high by 184 ft. long, which was built in 1743, strengthened about 1780, and stood intact until Feb. 25, 1888, or for over a century, when it gave way by "inherent weakness"; a weakness, we may add, which was singularly long in developing. The new structure was illustrated in ENGINEERING NEWS, June 16, 23, 1888. This dam is probably the oldest water-works dam on the continent, antedating by 11 years even the Bethlehem, Pa., works (1754) which are the second oldest on the continent and the oldest which can be said to have had a continuous existence. We believe, however, the Brunswick dam was not originally built for water supply purposes.

In Pennsylvania we have only 5 masonry dams reported, the largest being that at Scranton, 35 ft. high by 320 ft. long. The Fairmount dam at Philadelphia is a crib dam 30 ft. high and 1,112 ft. long, the old one built in 1819 having been renewed on substantially the same plan in 1872.

In Maryland there is a 40 ft. masonry dam, about 500 ft. long, on the Baltimore works, and another 34 ft. dam; while the Potomac dam for the Washington water-works, 2,877 ft. long by a maximum of 20 ft. high, closes the list, being the largest cut stone dam for water-works purposes (if not for any purpose) in the United States.

There are only a few scattering crib dams in the Middle States, besides that at Philadelphia. The type is not favored, although largely used for manufacturing purposes.

TUNNELS.

The water-works tunnels are not very numerous but decidedly important, including the new Croton tunnel, 30 miles long and a few feet; the Baltimore tunnel 7 miles long (36,500 ft.); the Washington tunnel, 4 miles long (20,716 ft.); a tunnel of 870 ft. at Albany, 356 ft. at Troy; and probably 3 or 4 others of short length through rock, besides a sub-aqueous tunnel of 1,020 ft. at Buffalo. Erie takes water from Lake Erie through a 48-in. pipe 1,000 ft. long, laid in a crib, extending out to take water from a point 13 ft. below the surface. Dunkirk takes water directly from the shore.

The stand-pipes of the Middle States will be summarized later with those for all the rest of the United States. We have records of a great many more than appeared in Mr. STEPHENS' paper, published in ENGINEERING NEWS of Oct. 6, 13, 1888.

LARGE TOWNS STILL UNSUPPLIED WITH WATER-WORKS.

We find by comparison with the census records of 1880 that in spite of the fact that nearly half the works are in towns of less than 3,000 population, there are in each State the following towns of 4,000 population, or over, which have no water-works or (possibly) which have water-works which have escaped our notice. If the latter should be the case in respect to any of them, we shall be obliged for information to that effect.

Owing to a blunder in the census records, the list is in part deceptive as to the New England States, and gives an unfair comparison of them with the Middle States. In the latter only those towns were included as places of 4,000 inhabitants or over which had a town population proper of that size, within village or borough limits; as is plainly proper to do. In the corresponding census list for the New England States all (or most of) those which had a total population in the "township", of perhaps 6 miles square, of 4,000 or over were included as "towns" of that size. In

the following list for the New England States, only Ellsworth, Me., has the actual town or city population correctly given. The rest are all of them township populations, and should be reduced by 2,000 to 3,000 to get at the real town or village population. Thus, Stratford, Conn., the only town on the list for which we can give both populations, has a township population of 4,251, but a borough population of only 2,540. Still, with this reservation, the following list represents fairly well the large towns which still remain without water-works, several of which will be seen to have works already in progress, for only those are noted as "proposed" which were regarded by us, in compiling our record, as substantially arranged for:

New England Towns of 4,000 Inhabitants or over without water-works,

[All the subjoined are townships, including perhaps 1,000 to 2,500 of country population, except Ellsworth, Me., which is a city.]

MAINE.	Pop'n.
Cape Elizabeth	5,302
Eastport	4,006 (proposed)
Ellsworth	5,052 (proposed)

NEW HAMPSHIRE AND VERMONT, *none.*

MASSACHUSETTS.	Pop'n.
Andover	5,169
Barnstable	4,242
Blackstone	4,907
Millbury	4,741
Montague	4,275
Needham	5,252 (proposed)
Northbridge	4,055
North Brookfield	4,459
Provincetown	4,346
Salisbury	4,079

RHODE ISLAND,	Pop'n
Burrillville	5,714 (proposed)
Coventry	5,714 (proposed)
Cumberland	6,445
Lincoln	13,765
South Kingston	5,114
Warwick	12,164 (proposed)

CONNECTICUT.	Pop'n.
Enfield	6,755
Groton	5,128
Manchester	9,462
Newtown	4,013 (proposed)
Portland	4,157 (proposed)
Stratford	4,251
Thompson	5,051
Vernon	6,915

Middle States Towns and Cities of 4,000 inhabitants and over without Water-Works.

[Including only town or cities proper, with no country population included.]

	Population.
Edgewater, N. Y	8,044
Geddes, N. Y	4,283
Harrison, N. J	6,898
Plainfield, N. J	8,125

[Pennsylvania and Maryland, *none.*]

In addition to the preceding, Elmira, N. Y., (20,541 population) was by the accident of a delayed report, not included in any of the tabulated Middle States statistics, although it will be found to be included in the summary of these summaries, giving the status of the water-works of the whole United States.

PERSONAL.

DAVID A. STEWART, Chairman of Carnegie, Phipps & Co., died Dec. 14 at Pittsburg, Pa.

J. R. CARTER, City Engineer of Birmingham, Ala., has been re-elected to his position.

MESSRS. STEVENSON TOWLE, CHAS. E. EMERY and SAML. MCELROY have been appointed a Board of Engineers to report on the St. Johnland (Kings Co.), L. I., sewerage problem.

W. B. HANLON has been appointed Chief Engineer of the Cleveland, Lorain & Wheeling road, vice C. M. BARBOUR resigned.

ED. C. LALONDE, General Manager of the Montreal & Sorel railway is now also Secretary and Treasurer, succeeding E. C. WURTELE.

CHAS. F. MAYER, Jr., a civil engineer, died in Baltimore, Md., Dec. 18. Mr. MAYER was prominently connected with South American railroad interests.

ELISHA ATKINS died at Boston Mass., Dec. 9, at the age of 75. He was connected with the elder AMES in founding the Union Pacific Railroad and for many years was the First Vice President of that road. He was also formerly President of the Little Rock & Fort Smith road, and had large interests in other western roads.

WILLIAM R. DAVENPORT died recently at Erie, Pa. He commenced life as a railroad clerk and next engaged in the manufacture of car wheels. In 1871, he with Judge GALBRAITH and JOHN FAIRBAIRN established the Erie Car Works.

Capt. ANDREW JACKSON WHITE, of Milner, Ga., died Dec. 17, at the age of 74. After the war he was elected President of the Macon & Western and Savannah, Griffin & North Albama railways, and held these positions until the roads were leased to the Georgia Central in 1871.

WATERMAN STONE, Superintendent of the Providence, Warren & Bristol Railroad, closes his connection of 24 years with that company on Dec. 31, to accept the position of General Manager of the Inter-State Rapid Transit Railway Co. of Kansas City. Mr. STONE has likewise been for many years Secretary of the Association of American Railroad Superintendents, and has done much to promote its prosperity.

Gen. JAMES C. LANE, who died recently in New York, was born in this city July 23, 1823. After being graduated at Poultney, Vt., in 1841, he made a specialty of architecture and of civil engineering, which he carried on until 1851. He aided in the construction of the Illinois Central Railroad. Later he entered the United States Coast Survey at Washington and was afterward engaged in mineralogical surveys in San Domingo, Porto Rico, and Cuba. He saw active service during the war. Since the close of the war he had been engaged in mineralogical surveys in California, Arizona, Nevada and Lower California, as well as in topographical surveys in Palestine. He was also engaged as Chief Engineer of the South Side and of the New York, Woodhaven and Rockaway railways of Long Island, and at the time of his death had just completed his duties as chief engineer of the new parks of Westchester County.

J. T. HABAHAN, General Manager of the Louisville & Nashville, has resigned to accept the appointment of Assistant General Manager of the Lake Shore & Michigan Southern; he succeeds the late E. GALLUP. Mr. HABAHAN entered railway service in 1864 as switchman at Alexandria, Va. He was afterward employed in the shops of the Orange & Alexandria road, and for six months was engine dispatcher and engineer on that road. In 1865 he was yardmaster of the Nashville & Decatur road at Nashville. In 1866 and 1867 he was conductor on a construction train, and 1868 and 1859 conductor on the Clarksville division of the Louisville & Nashville. During part of 1860 and 1870 he was yardmaster of the Louisville, Cincinnati & Lexington, and also a passenger conductor on the same road. From 1870 to August, 1872, he was in charge of the Shelby road; August 1872 to 1879, Roadmaster, Nashville & Decatur; 1879 to 1881, Superintendent, Memphis division, Louisville & Nashville; 1881 to 1883 Superintendent New Orleans division, Louisville & Nashville; from December 1883 to July 1, 1884, General Superintendent, Louisville & Nashville south of Decatur, and since July 1, 1884 to date, General Manager of the entire Louisville & Nashville system. A few years ago, however, he severed his connection with the Louisville & Nashville and accepted a position with the Baltimore & Ohio, but remained with that system only a short time, when he returned to the Louisville & Nashville.

The Canadian Pacific Railway.

VII.

MANITOBA AND THE CANADIAN NORTHWEST.

The change in the appearance of the country at Winnipeg is very decided and abrupt. For more than 1,200 miles east of it no good agricultural country is passed through, and most of it is of a very forbidding nature to the would-be settler, and still a virgin wilderness. Except from possible development of mines and quarries at special points, it does not seem possible that it can ever be occupied by any considerable population, and these conditions hold almost to the very bank of the Red River of the North, on which the future great city of Winnipeg (as it seems possibly destined to be) is situated. But immediately that the river is crossed, the appearance of the country becomes wholly different, level as a billiard table, and fertile as any Illinois prairie, with which alone the richness of the soil can be compared. These conditions continue without any change or break for 200 miles west, where a gradual thinning of the soil and raising of its surface begins, but without any very serious change for 156 miles more, to the town of Regina, the capital of the vast North-West Territory, which has a population of 800 and an altitude of 1,875 ft. above the sea.

Beyond that point for the next 500 miles to the foot of the mountains, the impressions of the casual traveler are exceedingly dismal. The soil is thinner than before, the altitude higher, the country almost uninhabited (the only considerable settlement on the whole distance being Medicine Hat with 400 to 700 population, and Calgary, a thriving town near the foot of the mountains in a fine ranching belt of limited width, with 2,000 or more inhabitants. The soil is for a good part of the distance more or less alkaline, there is no high ground for storing irrigation water, and the only living things encountered in great numbers are myriads of mosquitoes, whose ferocity would more than do credit to the Jersey marshes.

Nevertheless, it is claimed with some show of probability that this whole region is really arable, that the land to the north and south of the railway is still better than that visible from the line itself, and that the North-West Territory is destined to become hereafter the home of "teeming millions", and the great wheat country of the world. It is pointed out that it is only within a decade or so that Dakota has been regarded as habitable: that Manitoba wheat is of the very finest quality, and averages more to the acre than in any other region of the world; that the difficulties of climate which dismayed the early settlers have been studied and overcome; and that the country a thousand miles and more northwest of Manitoba is known to be arable and habitable, with little if any worse climate than in the region to the South.

All this has a strong element of probability in its favor. It is quite certain that very near to Winnipeg is the center of cold of the Continent, and that the climate grows steadily milder as we go west toward the Rocky Mountains, despite the higher elevation. The same holds true in less degree as we go northwest. A friend of the present writer happened to hear lately a pretty strong evidence of this in the address of a missionary who had lived for years in Athabasca (a region due east of Sitka, Alaska) and who narrated as one of the reliefs of missionary life in a missionary address how they had gone there with a small bag of seed potatoes and seed wheat, and in three or four years had the greatest abundance. The testimony was direct, disinterested and unquestionable that there is in that great region a vast area of exceedingly fertile land, where a certain few important crops can be raised in great abundance, nor is there any climate within it much worse, if any, than that of Manitoba and Dakota. Abundant evidence secured by Governmental inquiry and otherwise is to the same effect. One reason why this should be so, when the corresponding regions of the United States due south of it are hopelessly arid and dry without irrigation is revealed in a map of comparative evaporation which will appear next week; and which we must confess we have studied with no little interest on this account alone. Granting that an equal rainfall fell on the entire region, it is apparent that it would be likely to be very speedily evaporated again in the Southern region and not in the Northern, which might well make all the difference between fertility and barrenness.

That there is no lack of sufficient rainfall in the region around Manitoba, is indicated pretty strongly by the above record of the rainfall of the current

RAINFALL OF 1888 AT REGINA, N. W. T., TO JULY 16, INCLUSIVE.

Date.	Depth in 24 hours.	Remarks.	Date.	Depth in 24 hours.	Remarks.
Feb.	....	Nil	June 11	.....	Slight shower
March	....	Nil	" 15	.09	Thund'rstorm
Apr. 13	....	Slight shower	" 17	.07	" "
" 15	....	" "	" 18	.....	Slight shower
" 16	.07		" 19	8.36	Thund'r st'rm
" 21	....	Slight shower	" 20	5.22	" "
" 25	2.12	Th'nd'r storm	" 21	4.14	
" 26	3.14		" 22	6.22	
" 30	....	Slight shower	" 23	1.15	
May 3	....	" "	" 25	.....	Slight shower
" 9	.09		" 27	.....	" "
" 14	0.13		" 30	11.16	
" 15	0.16		July 2	1.14	
" 19	0.12		" 3	.....	Slight shower
" 24	....	Slight shower	" 4	0.12	
" 25	....	" "	" 10	.....	Slight shower
" 28	....	" "	" 13	0.11	
June 3	.06		" 14	.....	Slight shower
" 4	0.19		" 15	.07	
" 7	....	Slight shower	Total	44.13	Inches
" 8	.04				

Certified correct.

WM. C. ASPREY, Staff Sgt. Observer.

year at Regina, which may be regarded almost as the extreme outpost of the present farming population.

On three days of this record, June 19, 22 and 30, the rainfall is phenomenal, and it will be observed that 37.53 ins. out of the total of 44.13 ins. fell in the fortnight from June 19 to July 2 inclusive, being a quantity far beyond all necessities of agriculture; a fair year's rainfall in itself, and much more than this region is generally credited with; but the remaining 6.61 ins. is fairly well distributed, and would appear to have been quite enough for the agricultural necessities. After July, very little rain falls, which is of course an advantage, especially as the soil is of such nature that the roots penetrate far down within it.

Another fact which works in favor of this region is the longer daylight of the summer days, having the effect to shorten very perceptibly the length of season required to mature crops and thus compensate in a measure for the shortness of the season. That the season is intensely hot while it lasts we can testify from experience; and certainly during the current year nothing more fertile could be imagined than the appearance of the Manitoba prairies as they looked in the last week of July when crops were still young, or the last week in August when they were fully matured and largely reaped.

On the other hand, the admirable weather maps which accompany the U. S. Census of 1880 tell a different and more discouraging story. It is difficult to summarize their showing fully without reproducing them, but we will endeavor to do so partially, as the question of the future of the Canadian Northwest is one of continental importance.

The lines of mean annual temperature correspond substantially to what we have stated, showing a basin of "below 40°" centering near Winnipeg, with warmer country all around it; but still with a general tendency to east-and-west isothermal lines clear across the continent.

The lines of mean July temperature show this east and west tendency still more decidedly, there being a narrow belt of "65°-70°" clear across the continent on the boundary line, with all the lines below it nearly east and west except as broken through the Rocky Mountains.

The lines of mean January temperature show a still more decided basin of cold around Winnipeg with isothermal lines trending northwest from it, so far as can be judged from the lines within the United States. In the rest of the United States the isothermal lines are much more nearly east and west.

The lines of maximum temperature run nearly north and south, the hottest being close under the Rocky Mountains, corresponding to what we know to be the facts. In the main body of the Canadian northwest, 105° to 110° is attained; in Manitoba, 95° to 100°. The lines of minimum temperatures, on the contrary, are almost exactly east and west, out to the Rocky Mountains, and very quickly succeed each other, —56° being the interesting minimum along the whole prairie section of the C. P. R., over which the winds sweep with unbroken force, but, by a fortunate provision of nature, rarely when the thermometer is very low.

The admirable rainfall maps are still more interesting and significant. The lines of equal *annual* rainfall run nearly north and south, splaying out greatly though toward the Canadian frontier, so that that whole vast prairie region cannot by the showing of the map, if the map be correct, be credited with more than "10 to 15 ins." rainfall between the mountains and Regina, nor more than about 25 ins. at Winnipeg.

The spring and summer rainfall, which is the more significant factor, follows an almost identical distribution, the lines of equal rainfall being nearly north and south, but splaying out still more decidedly toward Canada, and indicating 5 to 10 ins. summer fall over the westerly plains and 10 to 15 ins. at Winnipeg, at least 5 ins. less than the average of Dakota.

These maps are based on the observations of years at hundreds of signal service stations. They will justly outweigh any amount of individual or isolated records, such as that at Regina, just quoted, the most convincing contrary evidence being the greatly less evaporation in this region, as will be shown next week. But it cannot but seem strange to the disinterested observer who is only anxious to get at the facts, that although every effort is being made in Canada to direct emigration to this region, and although very large claims indeed are made for it, yet there is no effort made to show scientifically and definitely from the records precisely what the climatic peculiarities of this region are. Why do they not do this? The records exist, covering over a hundred years at a hundred or two different Hudson's Bay posts, and it cannot but create doubts that these records are not spread out in full, in scientific way, where they can be got at.

We can get at some idea of the prospects of this region, however, by studying the past and present of Manitoba, which is undoubtedly the cream of it. We cannot attempt to do this, however, in this issue.

Work of the U. S. Engineer Bureau in 1887.

The report of the Secretary of War for the fiscal year ending June 30, 1888, was submitted to the President on Nov. 30. The following abstract gives an account of the doings of the Engineer Bureau for the year 1887, and some of the recommendations made:

Again the attention of Congress is directed towards "the defenseless condition of our sea-coast and lake frontiers," and the sum of $2,840,000 is asked for to commence the construction of modern gun and mortar batteries. For the preservation and repair of existing works $200,000 is requested; also, $1,890,000 for submarine mines and torpedo systems, and small sums for the Engineer School at Willet's Point and other incidentals.

The river and harbor bill passed by the 49th Congress having failed to become a law, the work on harbor and river improvement has been prosecuted during the last fiscal year from balances remaining on hand from appropriations made under the act of Aug. 5, 1886. The report of the Chief of Engineers gives the detail of this work and estimates for the fiscal year ending June 30, 1890.

The record of the improvement at the South Pass jetties of the Mississippi river shows that the legal channel has been maintained for the full period of one year, to Sept. 29, 1888, and $100,000 has been paid together with $50,000 for one year's interest on $1,000,000 retained. The total expenditure for this work to the date above given inclusive, is then $5,600,000 Under the act of March 3, 1875, one half of the $1,000,000 retained as security is to be paid to JAMES B. EADS, or his legal representatives, when the prescribed channel shall have been maintained 10 years. This period will probably expire during 1890, and $500,000 is inserted in the appropriations for that year. If this appropriation is not made, the act of March 3, 1875, directs the Secretary of the Treasury to issue bonds of the United States, bearing 5 per cent. interest, at par to said EADS or his representatives in payment of their claim.

The water supply of Washington, D. C., is next touched upon, making no mention of the frauds in lining as these were discovered later than June, 30. At that date the tunnel lining work had reached a total length of 13,080 ft. and 7,616 ft. yet remained to be lined. The reservoirs were completed in October, 1887, and work on the influent and effluent gate-houses, etc., were contracted for and commenced.

On the Potomac Flats a channel had been dredged from 350 to 550 ft. wide and 20 ft. deep between Georgetown and Giesboro Point. The Washington channel has been dredged to a width of 350 ft. and depth of 20 ft., and all the material was deposited on the flats, and up to the present time 544 acres were thus reclaimed from overflow at high-tide. Of the 12,000,000 cu. yds. required to raise the height of the flats 3 ft. above the highest freshets, 6,511,000 cu. yds. have been deposited. On June 30, 1888, the expenditure for this improvement amounted to $1,247,495, less than half the estimated cost of the whole work.

The Secretary of War suggests that some action be taken by Congress to enforce the rights of the United States in navigable waters within the limits of a State in regard to bridges over such waters. The Attorney General has decided that Section 8 of the Rivers and Harbor Act of 1884, does not prevent the erection of bridges that obstruct navigable streams; and while the act of 1888 empowers the Government to impose and collect fines, there are some cases where the railroad company could better afford to pay a fine of $500 per month than to build a proper bridge.

Failure of the Cast Steel Gun.

The official report on the cast steel gun made by the Pittsburg Steel Casting Co. and failing under the test at Annapolis last week, is as follows:

At 2.20 P.M. the first round was fired from the gun to fit the pad. The charge used was 36 lbs. of brown prismatic powder, O. P, with a common shell of 100 lbs. weight. After the delay of 15 minutes, requested by Mr. HAINSWORTH, the test was begun, it being proposed to fire ten rounds as rapidly as possible with charges of 48¼ lbs. of brown prismatic powder O. P. C. At the first round the gun burst. Twenty large pieces were recovered. The breech was torn off in an almost perfect ring 6 ins. long and blown to the rear, a distance of 130 ft. The breech plug remained in this piece, locked, and was unlocked and withdrawn exactly as usual and without any effort. The pressure gauges were not injured. Their records show a pressure of 14.1 tons. The muzzle and forward chase of the gun in a single piece were thrown 10 ft. to the front. One rather large fragment—weighing about 600 lbs.—escaped from the shelter and fell 90 ft. away. The shelter was destroyed, though it sufficed for its purpose and the roof of the velocity battery was completely wrecked.

"The appearance of the fracture is in many cases very peculiar. Only two flaws have been detected, but there is a striking lack of uniformity of the granulation at different points. An attempt will be made to illustrate this clearly by photographs. The projectile has not yet been found. It was at first thought to have entered the butt some 10 ft. above the point aimed at, but this is found not to have been the case, and I am disposed to think that it passed either over or to the left of the butt and fell in the water. It may, however, be found in the butt."

This report is signed by AUSTIN M. KNIGHT, lieutenant inspector ordnance in charge. Accompanying this report were photographs showing the destruction done and the appearance of the platform and gun carriage after the wreck had been cleared away

Book Reviews.

Architectural Wrought Iron, Ancient and Modern: A Compilation of Examples from various Sources, of German, Swiss, Italian, French, English and American Iron Work, from Mediæval times down to the present day. By WILLIAM WINTHROP KENT, Architect, New York: Wm. T. Comstock. Large 8vo. pp. 34, 36 plates, numerous cuts, $5.00.

This beautifully engraved and printed volume is, of course, chiefly addressed to architects. It is another of the many evidences of the growing demand for artistic excellence in the design of all construction details, in no one of which has there been greater progress made in recent years than in wrought-iron work, some of the most beautiful forms of ornamental iron-work being now of modern origin, and to be found in the very newest buildings of our large cities. They are, however, to a large extent mere revivals or extensions of designs centuries old, and in collecting with critical skill so considerable a collection of the best ancient and modern designs for ornamental wrought-iron work, as for grilles, gates, guards, wings, door knockers, wall rings, etc., Mr. KENT has rendered a service which must be highly appreciated by architects, and which might well be found suggestive to engineers likewise, as showing what slight additional work is necessary to give some artistic character to the many forms of crude and heavy wrought-iron work which they have occasion to design. An admirable humorous cartoon appeared some years ago in a German periodical called "æsthetic railroading". Every detail of the trains, station and appurtenances, like the telegraph poles, baggage trucks, etc., etc., including the hats and clothing of the employés, had been designed in the most pronounced style of modern æstheticism with a decidedly ridiculous effect; but there was a certain moral to the picture outside of its humor, in the evidence it gave of how slight changes were necessary to alter a bare, bald structure into something with an element of beauty and grace about it as well as of utility. To the same possibility, many of the designs in Mr. KENT's book bear still more decided testimony because without the element of exaggeration; although of course most of the designs are of a character which can only be properly studied or handled by architects.

The text of the work is naturally brief; the designs can speak for themselves more effectually than could any amount of written description; but they are preceded and accompanied by a critical analysis of the conditions of good design, illustrated by examples, which is exce2

lently done, and adds greatly to the value of the work. The chief and only fault to be found with the work, so far as we perceive, is that it is too short. The number of designs given might have been doubled and tripled to advantage, and the range of subjects considerably extended, without the least danger of exhausting the subject; but enough is given to be suggestive, which is no doubt the main purpose of the work, and the number of plates may perhaps be extended in future editions. As it is, the work is a fine one in all respects, giving a large and carefully selected collection of the *best* examples of designs in wrought-iron; with a sufficient exposition of the reasons why they are the best. As a pupil of the late Mr. RICHARDSON, who is now generally admitted to have been the greatest architect who has lived for many centuries, Mr. KENT brought with him peculiar qualification for preparing such a work, and one of the neatest examples in it of what can be accomplished by pure grace of form without any elaborative or ornamental work whatever is, to our thinking, a modest little sketch in the lower corner of Plate XXIV of an "andiron for Mr. RICHARDSON'S study", designed by the author.

The Design and Construction of High Masonry Dams giving the Method employed in Determining the Profile of the Quaker Bridge Dam. By EDWARD WEGMANN, Jr., C. E., M. Am. Soc. C. E. Div. Eng. New Croton Aqueduct, N. Y., New York: John Wiley & Sons, quarto, pp. 105. 56 large plates, 16 cuts, 24 tables. $5.00.

The profession is to be congratulated that the large amount of material as to the history, design and construction of other great dams which was collected to aid in preparing a design of the Quaker Bridge dam has borne fruit in this highly creditable volume, chiefly devoted to the presentation of the actual facts in regard to the great existing dams, but supplemented by some highly useful plates and tables comparing theoretical types.

We take the work to be, beyond doubt, the most complete compendium of information in regard to high masonry dams which exists in any language, and as such, a most valuable addition to engineering literature.

It cannot indeed be claimed, for reasons known to our readers, that this large amount of information collected for the Quaker Bridge dam was used to very good purpose in the preparation of the first design for that work; and it tends to throw legitimate doubt upon the methods of computation used that they led to so highly objectionable a plan and profile as that which we had occasion to criticise early in the present year, and which has since been radically revised and greatly improved by the Board of Experts whose conclusions were given and discussed in our issues of Nov. 3 and 17. But, although Mr. WEGMANN was charged with the mathematical work connected with the preparation of designs, yet he was not the designing engineer, and we observe with satisfaction that his work neither repeats the exaggerated claims which were put forward in favor of straight dams vs. curved, nor defends the disproportionate thinness of the upper part of the dam, which in fact it is expressly proposed in the frontispiece of the volume to make thicker.

While Mr. WEGMANN has done valuable and most useful work in his presentation of the theories and conclusions of various engineers in regard to the proper profiles of dams, enabling them all to be readily compared, so that the engineer has before him in this volume practically all that former engineers have thought and done in the matter, yet we cannot altogether approve of his exposition of the theoretical side of the subject. It is not long, only some 50 pages in all, and most of it very useful matter, but there has not been the effort made that there should have been to simplify and classify the presentation of the subject, rather than to dwell as important or significant on the futile efforts of half a dozen mathematical writers to formulate what we may call an equation of the profile, in which we have only to substitute certain constants and get the profile for any dam offhand from the formula. Of course we cannot do it without great complexity; any more than we can in a similar way express the weight of bridges or best form of rail by equations. But the necessary mathematical steps for the design of a single bridge are simple, nevertheless; and for the design of a single dam still simpler; the only real necessity being to assume a trial profile, compute its pressures and stability at intervals of 30 or 40 ft. in height, make certain modifications if necessary, and let that end it, being merely sure to have the dam *strong enough*, for of all engineering structures a high masonry dam is about the poorest to try experiments with. The fact that doctors disagree to such an extent as both the theoretical and actual profiles of Mr. WEGMANN'S volume show is the best of all evidence that the absolutely best profile can not be determined mathematically; and when we further remember how vastly more certain unknown and unknowable factors, like the quality of the stone, cement and foundation, the fidelity of the contractor, elastic yielding, the chances of the weather, of ice and waves, of hydrostatic pressure under the mass, and what not, have to do with the ultimate stability of a dam than the scientific exactitude of its profiles, we shall see how entirely needless it is to exhaust one's brains in efforts to make the maximum pressure in each successive layer precisely 8.19 tons per sq. ft., and neither more nor less; and it is only when such efforts are indulged in that the mathematics of the problem becomes in any sense abstruse.

This fact Mr. WEGMANN might well have brought out more clearly than he does; but after all not to do so is a minor fault, and it is unquestionably well that in a standard work of this character (and it must certainly be regarded as such) all the conclusions of all writers on the subject should be brought together and contrasted, as notably the leading writers, SAZILLY, DELOCRE, PELLETREAU, RANKINE and COVENTRY.

We cannot attempt to follow through in detail the various steps of the formulæ which the author proposes for computing the profile of a dam, and which were used in designing the Quaker Bridge dam. They are probably simpler and better than those which have been heretofore in use to accomplish the same result, and they do not necessarily involve any great amount of numerical work in applying them; but they become unnecessarily complex when used, as they have been used, to compute very thin successive layers, and do not necessarily lead to a good or even admissible profile, it appears to us events have proved. This, however, is rather a fault of the application of the formulæ than of the formulæ themselves, which it is well to have permanently recorded, and for elaborating which Mr. WEGMANN deserves great credit.

In Chap. VI. we first begin to deal with the construction of dams, and the chapter opens with a brief discussion of the question of plan, straight vs. curved. This discussion errs chiefly by omission. The subject is somewhat carefully fenced with, as would be natural from Mr. WEGMANN'S official relations, and while there is little stated with which fault can be found, by implication and omission it tends rather to false conclusions.

But with the exceptions noted, we have nothing but good to say of the whole contents of the work. It will long be the first of its class. It describes in detail 44 dams, only 23 of which were referred to in the report of Messrs. CHURCH and FTELEY, of the New Croton Aqueduct, which is the next most complete compendium of information on this subject; and those which their reports refer to, are re-referred to only briefly. Mr. WEGMANN gives quite full information as to all. One thing more he might well have remembered to do to make his work complete; to refer in connection with each dam to all fuller descriptions to be found in print; which he could have easily done, but some reader may not find so easy. For all ordinary uses he gives enough himself, but it would be well to add such a list of references to the bibliography.

We regret that our space does not permit us to give a fuller summary of this excellent treatise, which will doubtless soon be in the libraries of all engineers interested in the subject.

A trifling grammatical criticism it is perhaps well to note, since we have observed reason for it in other engineering writings. To speak of "maxima pressures," etc. is not good English. We may use maxima and minima as a plural noun, because the English language recognizes a singular and plural form for nouns, but the English adjective has no plural form and any adjective qualifying an English noun becomes for the nonce itself English, as maximum unquestionably is. It should be used in that form only both with singular and plural nouns.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—A regular meeting was held Dec. 19; Vice President J. J. R. CROES in the chair. The Secretary read a description of tests of the efficiency of different methods of treatment for protecting wood from the teredo. The tests were made at Perth Amboy, N. J., by the Lehigh Valley R. R. Co., and were fully described in ENGINEERING NEWS, Sept. 1. In the discussion, Mr. COLLINGWOOD stated that the worms may generally be found near the low water line, and near the mud; he had found them at the mud line of piles treated with wood oil; the piles had been in place about 3 or 4 years. The Docks Department of this city has also found worms near the mud line in sticks of timber used as piles for the piers. Wood oil be believed to be good, but whether as good as dead oil (creosote) remains to be seen. As proof of the care required in the process of treating, he instanced a case in which oak sticks had been spoilt by overheat and too great a quantity of creosote: in this case the contractors apparently tried to do a particularly good job, but carried it too far, the wood being warped and twisted. Mr. COOPER said that it is well known that where the bark is on, the worms will not enter, but you cannot keep the bark on in driving piles. Cases were instanced in which parts of piles on which the bark had remained were found free from the worms, while in other parts the wood was badly eaten away. Reference was also made to the "vulcanizing" process, a hot air process by which it is claimed the wood is hardened and made durable without injecting any material. The works are at 1st Ave. and 15th St., New York, and engineers have been invited to inspect the process. A case was instanced in which the acids in the timber of an electrical conduit ate away the lead casing of the cables. This was apparently due to bad treatment of the wood.

Mr. BOGART, State Engineer of New York, exhibited drawings of lift bridges on the State canals. They are used where the grade of the street is very little above the level of the canal. The State builds the bridges, but the city has to operate them; they are so made that in case the city fails to attend to them, they will rise of their own accord, the State having the right of way. The average span is about 90 ft., including a 70 ft. water-way and 2 tow-paths; the clear headway is 12 ft.; the average cost for a bridge of 90 ft. span is $9,000. The roadway is hung from elevated trusses by wire ropes. They are generally operated by hand, but in some cases turbines are used. The roadway is counterbalanced by weights of pig-iron and extra weights are attached to bring the bridge down; these weights have to be wound up again after each opening of the bridge. A sidewalk is built on the elevated trusses, with stairs at each end, so that pedestrian traffic is not stopped when the bridge is opened for boats. The first bridges of this type were designed by SQUIRE WHIPPLE.

The following circular of enquiry as to a suggested visit to Europe, has been issued:

The Board of Direction informs the members of the Society that the following communication has just been received from the Institution of Civil Engineers.

THE INSTITUTION OF CIVIL ENGINEERS,
25 Great George St., Westminster, S. W., Nov. 23, 1888.

To the Secretary of
THE AMERICAN SOCIETY OF CIVIL ENGINEERS,
127 East 23d St., New York, U. S.

SIR:

It is reported that many engineers from the United States will probably visit Europe during the International Exhibition which is held in Paris in 1889.

In view of this, the Council of the Institution of Civil Engineers at the first meeting of the present session, directed, an inquiry to be addressed to you to ask:—1, Whether this report is correct, and, if so, whether your Society can give any idea of the number of your members likely to come—2, Whether they will travel by way of England; and—3, What may be expected to be the approximate date of their arrival and the duration of their stay in this country.

The object of this inquiry is to enable the Council to consider the possibility of making such arrangements as may best tend to further the objects which the visitors have in view, and to render their visit generally as useful and agreeable as possible.

The Council need hardly assure you of its good will towards its professional brethren in the United States, and of its desire to embrace this opportunity of manifesting its friendly feeling to the utmost of its power.

Of course, in any case, the facilities afforded by this Institution are always at the disposal of your members. We are, yours faithfully,

GEORGE B. BRUCE, *President.*
WILLIAM POLE, *Hon. Secretary*
JAMES FORREST, *Secretary.*

This circular is now issued so that a proper reply may be made to the above letter.

For the information of members, the following additional facts are given: An invitation has been extended to the American Society of Mechanical Engineers, by the Institution of Mechanical Engineers of London. We are informed that it is expected that other foreign Engineering or Scientific Societies will also arrange for special courtesies, and that in all these the members of this Society will be included. The American Institute of Mining Engineers and the American Society of Mechanical Engineers, are taking steps to ascertain the probable number of their members who would visit Europe next Spring in case special arrangements are made.

The following information has been secured by a Committee of the American Society of Mechanical Engineers as to practicable arrangements, and these or substantially similar arrangements can be made for the members of the American Society of Civil Engineers and their families.

DATES.—Minimum absence 5 weeks. From, say, last week in May to first week in July.

COST.—Round trip passage by steamer about $110.00, going altogether in a body and returning individually at any time during the year, as may be convenient. Cost per day in Europe from $4.00 upwards.

To determine; first, what reply to make to the communication of The Institution of Civil Engineers, and second,—what arrangements, if any, should be made as to securing passage, rates, etc., a speedy reply to this circular is necessary. The replies will be canvassed at the monthly meeting of the Board of Direction, and should therefore be at the Society House by Jan. 2, 1889.

The Western Railway Club.—At the meeting of this Chicago club on Dec. 18, the subjects for discussion were: "Relative Merits of Thick and Thin Tires, and to what Extent are the Railways Moving to Adopt the Master Mechanics' Standard Center and Tire," "Water Circulation, and Purification of Water."

WALTER D. CROSMAN, *Secretary,*
94 Adams Express Building.

Missouri Association of Surveyors and Civil Engineers.—An adjourned meeting will be held Tuesday, Jan. 1, 1889, in the engineering rooms of the Missouri university at Columbia, Mo., for the purpose of urging upon the next general assembly such amendments to the statutes as will bring them into exact accord with the laws and instructions under which the original United States land surveys in Missouri were made. The subjects of "Registered Surveyors" and the "Road Laws" will also be up for consideration.

The American Economic Association is to commence its third annual meeting in Philadelphia on Dec. 26. This body is made up of "scientists political economists and

philanthropists." The President is FRANCIS A. WALKER, of the Boston Institute of Technology, and the Secretary is Prof. RICHARD T. ELY, of the Johns Hopkins University. Among the papers of more or less engineering interest will be the following:—Prof. J. W. JENKS on "Road Legislation for the American States"; another by Prof. H. C. ADAMS, of Michigan University, on "Interpretation of Railway Statistics", and by Prof. F. W. TAUSSIG on "Some Points in the Theory of Railway Rates."

Technical Society of the Pacific Coast.—A meeting of the Society was held at San Francisco, Cal., Dec. 7. President MANSON in the chair; ARTHUR F. PRICE, Secretary.

The chief business of the evening was an address by Lieut. F. P. GILMORE, U. S. N., on the relative tensile strength of plain and twisted iron and steel bars. Mr. GILMORE is the expert in the testing of metals, sent out to inspect the material used in the construction of the new war vessels. As the question had been raised whether iron rods used in the construction of cement sidewalks were weakened by first twisting them, in order to make the cement hold. Lieut. GILMORE made a number of experiments at the Pacific Rolling Mills and the Union Iron Works, and the result proved that twisted bars of iron or steel will bear a greater tensile strain than before being twisted. As many as 13 turns were made in a ¾-in. steel rod, 8 ins. long, before it broke, while rods of iron the same dimension broke at 3½ and 4 turns. Mr. GILMORE stated that iron and steel will bear a greater strain a few weeks after it has been manufactured than it will immediately after leaving the mills.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Ohio & Northwestern.—Track has been laid on this road during the present year from Portsmouth to Sciotoville, 5 miles, and the rails along the old narrow gauge line are now being replaced with heavy steel.

Canada Atlantic.—It is reported that a reconnoissance has been made for an extension of this road from its present western terminus at Ottawa, Ont., to Barrie, Simcoe Co., about 225 miles.

Louisville, New Albany & Corydon.—It is stated that an extension, 3 miles in length, from Corydon, Ind., is to be put under contract at once. M. J. O'CONNOR, of Corydon, is President.

Housatonic.—This Connecticut company will petition the next legislature for authority to increase its capital stock $4,500,000, for the purpose of purchasing leased lines and building certain branches.

Western New York & Pennsylvania.—Tracklaying on the extension from Hinsdale to Olean, N. Y., 6 miles is being rapidly pushed.

Maryland Central.—This road, extending from Baltimore, Md., to Delta, Pa., 44 miles, was sold at sheriff's sale last week to JOHN K. COWEN, WM. GILMORE, and others, representing the first mortgage bondholders. The company will be reorganized.

Cincinnati, Wabash & Michigan.—It is announced that the long contemplated extension from Anderson to Rushville, Ind., 36 miles, is to be built as soon as spring opens. NORMAN BECKLEY is General Manager.

Pittsburg & Lake Erie.—A two mile branch is under construction from Fallston Station to coal fields.

Philadelphia & Reading.—Surveys are in progress for the extension of the Kalmia branch into Clark's Valley to reach coal deposits.

New Castle & Shenango Valley.—This line which has recently been completed from New Castle to West Middlesex, Pa., will form part of the Erie system.

Freehold & New York.—This New Jersey company has been reorganized with EDWARD B. ADAMS, President, and JUSTUS E. RALPH, Secretary and General Manager.

Canadian Pacific.—The International Railway is now practically finished to Mattawamkeag, Me., and trains are to begin running in a few days.

New York & New England.—The important feature of the recent annual meeting was the ratification of the contract which has been closed with the Highland Bridge Co., which was effected with slight opposition. It was voted to form the New England Terminal Company to form a new freight line from Wilson's Point, on Long Island Sound, to New York. The purchase of the Rockville Railroad was also authorized.——It is reported that surveys are in progress from Hopewell Jc. to the Poughkeepsie Bridge, about 12 miles.

Cleveland & Wheeling.—

WHEELING, W. Va., Dec. 17, 1888.

EDITOR ENGINEERING NEWS:

This company is now engaged in building its double track railroad bridge across the Ohio river between this city and Martin's Ferry, Ohio, with extensive terminal tracks in both cities. The bridge will be 1,200 ft. long and 90 ft. from bottom chord to low water. The channel span is 535 ft. in length. JOB. ABBOTT is Chief Engineer. The company is building 50 miles of railroad to connect the Cleveland & Canton and other Ohio roads with the bridge here. Grading has been under way since June and is now in progress. We expect to lay the track during 1889.

R. H. COCHRAN, *Vice-President.*

Lehigh & Hudson.—The contract for building the Orange County Railway, the extension from Greycourt to Campbell Hall, has been awarded to P. P. O'Heiher, of Paterson, N. J., and John Claffey, of New York City; the work to be done by June 1.

Philadelphia & Reading.—The company is getting into good financial condition. The net earnings for the current year are estimated at over 10 million dollars, notwithstanding a loss of $1,500,000 due to the strike and the charging of half a million put into the sinking fund to operating expenses. The fixed interest, charges and rentals amount to $7,757,888, so that in the twelve months the road has earned 30 per cent. more than its fixed charges, and may be expected to increase this to 50 per cent., in a year of continuous operation. Its prospects in other directions are bright, for the Baltimore and Ohio connection cannot fail to bring it new business. The Reading managers are anxious to develop the export trade of Philadelphia, which cannot well be done until a regular line of European steamers is established. To encourage the organization of such a line, it is said, they are ready to guarantee a business of 7,000 tons every two weeks.—*Baltimore Sun.*

Boston & Maine.—It is stated that preliminary surveys have been made for a line from Manchester to Concord, N. H., parallell to the Concord Railroad.

Adirondack.—The extension from North Creek to North River, N. Y., 6 miles in length, which was graded seven years ago, is to be repaired and laid with track in time for next season's traffic.

Chippewa Valley.—This new Michigan company has bought the Luther & Manistee railway, and will utilize it as part of the line which it proposes to complete from Mt. Pleasant to Manistee, about 120 miles. The company has filed a mortgage to the Central Trust Co. of New York to secure bonds to the amount of $1,800,000 on its line.

Pittsburgh, Shenango & Lake Erie.—The Attorney General of the State of Pennsylvania has secured an injunction to delay the issue of bonds which this company proposes to make, on the charge that its securities are fictitious and do not represent their face value.

Kingston & Pembroke.—A project is being agitated at Kingston, Ont., to extend this road from its present northern terminus at Renfrew to Portage du Fort, P. Q., which would necessitate a bridge across the Ottawa river.

Baltimore & Eastern Shore.—This Maryland company has purchased the Wicomico & Pocomoke Railroad and took possession on Dec. 1. A traffic contract made with the Baltimore & Ohio, and the promise of financial aid from the company to the amount of $100,000 will have to be ratified by the new management, before it will be binding. The Boston owners of the Annapolis & Baltimore Short Line have promised to subscribe for $200,000 of the bonds of the East Shore Company, and it is hoped that construction can soon begin.

Baltimore & Ohio.—At the directors' meeting held on Dec. 19, CHARLES F. MAYER was elected President in place of SAMUEL SPENCER, the former receiving 13 votes and the latter 8. Mr. SPENCER gave a brief statement to the press that certain large holders of the company's stock had expressed a desire that Mr. MAYER should be placed at the head of the company, and that the recent change in the board of directors was made in accordance with that wish.

Dexter & Piscataquis.

FOXCROFT, Me., Dec. 14, 1888.

EDITOR ENGINEERING NEWS:

The surveys for this road, commencing at the Dexter & Newport R. R. and running through the towns of Saugerville and Dover to Foxcroft, a distance of 16 miles, are completed. It connects with the Dexter & Newport at Dexter and with the Bangor & Piscataquis at Foxcroft. It has been leased to the Maine Central for 999 years at a rental of $12,500 per year and is to be completed by Nov. 1, 1889. D. R. BROWN is Chief Engineer. There will be a large bridge across the Piscataqui river at Foxcroft. Grades are not very heavy. The estimated cost of the road is $250,000. Contracts will be let by Dec. 25.

J. B. MAYO, *President.*

New Projects and Surveys.

Toledo & Chicago Air Line.

GOSHEN, Ind., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:—

This railway is to run from Toledo, O., to Chicago, Ill., *via* Goshen, about 215 miles. W. L. STONEX is Vice President, W. R. ELLIS is Secretary and E. W. HAWKS, Treasurer. The line is not yet under survey, but is projected with fair projects of construction.

M. MERCER, *President.*

Keyport.—This company has been organized in New Jersey to build a railroad from the terminus of the Freehold & New York Railroad at Keyport to Atlantic Highlands. Part of the work will be done this winter. The company is closely connected with the Freehold & New York Company. JUSTUS E. RALPH, of Keyport, is Secretary, Treasurer and General Manager.

Rome & Carthage.—President JAS. C. SMITH and other officers of this New York company have had an interview with President DEPEW of the New York Central concerning traffic arrangements, etc., for their road. The people along the line are anxious to have the road built, but the money for the purpose does not seem to be forthcoming.

Middletown & Hummelstown.—This Pennsylvania company has been granted right of way for an entrance to Middletown.

Pittsburg, Cannonsburg & State Line.—This line, which is the Pennsylvania extension of the Wheeling, Wellsburg & State Line road, projected in West Virginia, is to be surveyed through to Pittsburg.

Coudersport, Hornellsville & Lackawanna.—The general offices of this company are to be at Hornellsville, N. Y. D. C. LARABEE is President, H. J. OLMSTEAD is Treasurer and C. L. PECK is Secretary.

White Plains & Elmsford.—The Board of Village Trustees of White Plains, N. Y., has voted to grant a franchise to the highest bidder for the construction of a 3 mile road from Elmsford, on the New York & Northern Railroad, to White Plains. The road must be in operation by July 15, 1889. The Port Chester, White Plains & Tarrytown Ry. Co., will bid for the franchise. The Board will hold a meeting to receive bids on Jan. 7, 1889.

Buffalo & Williamsville.—The annual meeting is to be held at the company's office in the American Block, Buffalo, on Jan. 10. The contracts made for the construction of the road are then to be ratified.

Ohio.—A rather peculiar scheme is reported as projected at Columbus, O., for, building a railway by a combination of State and private capital. It is proposed to utilize the berme bank of the Columbus feeder of the Ohio canal and the Hocking canal for a railway about 75 miles in length, terminating at Athens. The State would be asked to build the railway complete, which with the repairs to the grade is estimated to cost $1,000,000. A private corporation at a cost of another million, would equip it with motive power and passenger cars and build all required switches to the various coal banks along the route. Cars are to be furnished by shippers, as the traffic will be principally in coal, iron, fire clay and similar articles. The Governor would be President *ex-officio* of the enterprise, and all operations would be reported to the Legislature. Combinations with other transportation lines would be prohibited. The project seems to be still a mere matter of talk, and will probably remain so.

Penobscot & Aroostook.

620 Atlantic Ave., BOSTON, Mass., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:

The surveys for this line of railway, which is to run from Enfield through the towns of Howland, Maxfield, Mattamiscoutis and Medford to the line of the Canadian Pacific R. R., a distance of 8 miles, will begin in the early Spring. The work is generally easy and the grades low. There will be a bridge of from 800 to 1,000 ft. in length across the Penobscot river. Three miles right of way has been secured. CHARLES W. MELLEN of Oldtown, Me., is chief engineer, and SAMUEL L. MONTAGUE, of Great Works, Me., is Treasurer.

EUGENE H. CLAPP, *President.*

SOUTHERN.

Existing Roads.

Norfolk Southern.—It is reported that this line running from Norfolk, Va., to Edenton, N. C., is to be extended south. The move is supposed to be in the interest of the New York, Philadelphia & Norfolk Co.

Atlantic & Danville.—Contracts for the 60 mile section from Danville to Clarksville, Va., have been awarded to Messrs. Ruffin, Harston, James, Holland and Blair of Danville, and ground was broken at Danville on Dec. 15. About 150 miles of track are now laid and in operation. Grading is in progress on the 50 mile section between Clarksville and Bellfield.

Augusta, Gibson & Sandersville.—President R. M. MITCHELL of Augusta states that work will commence on changing the gauge to standard within 30 days, and that a proposed extension *via* Sparta, Eatonton, and Monticello to Griffin will be built at an early day.

Louisville Southern.—The most important event in Kentucky railway circles for some time was the 30 years lease of this road to the Louisville, New Albany & Chicago, reported last week. General Manager JOHN H. MACLEOD has resigned, and will assume his former office of Chief Engineer. It is stated that the lease will make no difference with the extensions now under way, and they will be pushed as fast as possible.

Wilmington & Weldon.—Contracts have been let for grading the Scotland Neck extension as far as Greenville, N. C., and the company has agreed to extend it to Jacksonville, Onslow Co.

Kansas City, Springfield & Memphis.—The Kansas City *Times* thinks President NETTLETON'S visit to Boston is for the purpose of inducing the chief stockholders of his company to assent to the proposed extension of the Kansas City, Memphis & Birmingham road to Atlanta, Ga., and the sea coast.

Norfolk & Western.—Rumors have been abundant that this company was likely to succeed in its attempt to purchase of the Richmond & West Point Terminal Co., the first preferred stock of the East Tennessee, Virginia & Georgia company, through which that system is controlled. Present indications are that the negotiations will not succeed, but a meeting of the parties interested is to be held on Dec. 20.

Owensboro, Falls of Rough & Green River.

OWENSBORO, Ky. Dec. 14, 1888.

EDITOR ENGINEERING NEWS:—

The survey of this road has been made for the whole distance, 38 miles, and contracts for building and equipment were let to J. W. M. FIELD, of Owensboro, in November. The road is to run from Owensboro through the towns of Whitesville and Fordsville to the falls of Rough river. The route is through a rolling hilly region

with level valleys and hills rising to 480 ft. above sea level. The principal sources of traffic will be agricultural products, lumber and minerals. Soil fine, timber superior in quality, iron ore veins workable from 6 to 20 ft., block coal seams 46 ins., 53 ins., and 56 ins., all above drainage, smelting coal, gas coal and steam coal, analyses best, also fine lithographic stone in abundance. Tracklaying will begin about May 1, 1889, to be completed by September of the same year. HENRY C. HERR is President and JAMES NIMAN, Chief Engineer. The capital for construction is a subscription of $75,000 from Owensboro, private subscriptions of $50,000, and bonds at $20,000 per mile for 28 miles. This is the best short line enterprise in Kentucky. No competing rail or water way within 25 miles.

R. S. TRIPLETT.

New Projects and Surveys.

Danville Branch.—

DANVILLE, Boyle Co., Ky., Dec. 13, 1888.

EDITOR ENGINEERING NEWS:—

A line of railroad to be called "the Danville branch of the Louisville & Nashville Railroad" has been projected with every indication of its being built, work to begin about Mar. 1. I have made surveys and located the route. The length is 45 miles.

Please send me a copy of the NEWS, as I wish to get hold of some of the advertisers. What machine for removal of dirt do you consider best? R. L. BLAKEMAN.

Union City, Louisville & Memphis.—

UNION CITY, Tenn., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:—

The Chesapeake, Ohio & Southwestern R. R., now the Newport News & Mississippi Valley, crosses the Nashville, Chattanooga & St. Louis at Paducah Junction, only three miles east of here, and the Mobile & Ohio at Rives, only 5 miles south of us. We have a growing and thriving town of 5,000 inhabitants, located at the junction of the M. & O. and N. C. & St. L. Railways. We want to get the advantage of another line of railway, hence our new project is to build a short line from here to Rives, where we intersect the N. N. & M. V. Ry. Our enterprise is just in its incipiency, but we expect to complete the job by July, as we will get under the "wing" of the N.N. & M.V. Co. Our company was chartered Nov. 1, 1888. As yet we have no Chief Engineer. We expect to begin the survey in about 90 days.

W. H. GARDNER, *President.*

Mississippi Southern.—It is reported that a railroad is projected to run from Natchez, Miss., to Pensacola, Fla. T. G. STUART of Louisville, Ky., is interested.

Meridian & Brunswick.—This company, whose headquarters are at Meridian, Miss., is obtaining subscriptions to its capital stock.

Waynesboro, Pascagoula & Gulf Coast.

WAYNESBORO, Miss., Dec. 17, 1888.

EDITOR ENGINEERING NEWS:

The preliminary survey of this road has been completed from the Gulf at the mouth of the Pascagoula river to Waynesboro, Miss. where it will intersect the Mobile & Ohio R. R., a distance of 107 miles. The route as surveyed runs through a fine timber region and can be constructed at a very small cost, there being no cuts or fills of any importance and only one large bridge. The company contemplates extending the road from Waynesboro through 80 miles of fine iron mineral region and thence to Memphis, Tenn., thus securing direct communication between the Northern markets and the Gulf. The harbor at the Gulf is navigable for vessels of 20 ft. draught and by the aid of government appropriations is being gradually deepened. No local aid is asked and right of way can be secured without any trouble. The company was incorporated March 6, 1888. P. S. LAYTON is Chief Engineer. J. R. S. PITTS, *Pres.*

THE NORTHWEST.

Existing Roads.

Duluth & Winnipeg.—At the annual meeting, held at Duluth, Dec. 14, A. W. WRIGHT, Alma, Mich., was elected President; W. H. FISHER, of St. Paul, Vice President and General Manager; G. W. WELLES, Saginaw Mich., Sec. and Treas. Work upon the road has been suspended for the winter.

Northern Pacific & Manitoba.—The surveys have been completed for the branch from Morris to Brandon, Man.

Centralia & Ste. Geneviève.—No tracklaying was done on this road this year. A meeting was held at Sparta Ill., recently, at which F. D. GILLETTE, the chief projector asked the citizens for a subscription of $2,500 in addition to the amount already collected on the old subscription of $7,500.

Chicago, St. Paul & Kansas City.—According to press reports, President STICKNEY of this company is at work on a scheme to consolidate the St. Paul & Duluth and the Duluth & Iron Range roads with his system, and also secure control of all the steam transportation lines on the Ohio and the Mississippi rivers.

Canadian Pacific.—It is announced that control has been secured of the Q'Appelle, Long Lake & Saskatchewan Ry. & Steamboat Co., which has built a railway from Regina northwest 23 miles. The company will extend the line next year to Saskatoon, and further extensions are now under survey toward Battleford and Prince Albert.

New Projects and Surveys.

Great Northwest Central.—It is reported that the CLEMOW syndicate have sold out their interest in this project to English parties. Senator CLEMOW denies this report, and states that negotiations are now in progress for securing English capital to build the line, which probably furnished a basis for the rumor.

Winnipeg & North Pacific.—This company will apply for an act of Parliament extending three years the time for beginning the construction of the railway and reducing to 20 the number of miles required to be built each year.

Chicago South Side Rapid Transit.—This Chicago company has recorded a mortgage to the Knickerbocker Trust Co., of New York to secure bonds to the amount of $7,500,000. The road to be built is commonly known as the South Side Alley Elevated.

Chicago & Calumet Terminal.—This belt line railway about Chicago is to start at South Chicago and run *via* Hammond, Ind., to Blue Island and thence in a direction not yet made public. The enterprise is being pushed in connection with a land development scheme. J. T. TORRENCE of Chicago is one of the chief promoters.

Hornville & Du Quoin.—HENRY HORN of Du Quoin, Ill., writes us that this recently incorporated company is only chartered to build and operate a switch, running to his coal mine about 2 miles southwest of Du Quoin, Ill.

THE SOUTHWEST.

Existing Roads.

Kansas City, Ft. Smith & Southern.

NEOSHO, Mo., Dec. 16, 1888.

EDITOR ENGINEERING NEWS:

This road is projected to run from Kansas City to Ft. Smith, Ark., 316 miles. Of this distance, surveys have been made on 168 miles. We have laid track this year from Joplin to Neosho, Mo., 20.7 miles, and from Neosho south, 2 miles. Will finish tracklaying on Dec. 18, and will resume work as soon as weather will permit in the spring. The line is graded 15 miles south of the end of track. The division between Neosho and Joplin will be opened for traffic on Dec. 20. I have located the line on the north through to Jasper Co., and on the south through Washington Co., Ark. Have made preliminary surveys south to Ft. Smith. Work is generally light. The maximum grades are 85, and maximum curve 5°. The line runs through a good wheat, corn and cotton country and an abundance of fine timber. Right of way is secured for 150 miles. The company was chartered in March, 1887. Col. L. L. BUSH is President.

S. R. PATTERSON, *Chief Engineer.*

Kansas City & Southern.—It is reported that this company is building a branch from Dodson, Jc. to Westport, Mo., and has it nearly completed.

St. Louis & San Francisco.—It is reported that a survey is in progress between Bolivar and Osceola, Mo., and that an extension will be put through to connect the system with the Kansas City & Southern, which it is rumored, is to furnish the system an entrance to Kansas City. The company has issued orders to make only the most necessary repairs on the bridges upon the southwestern extension, which now terminates at Red Fork, Ind. Ter., as it is intended to replace them with permanent structures of iron or steel at an early day. This is construed to mean that the extension to Albuquerque, N. M., is to be put through in the near future.

Ft. Worth & Rio Grande.—It is stated that this Texas company has purchased rails for its extension to Kerrville.

Missouri Pacific.—The Ft. Smith & Gurdon branch is to be extended from Greenwood, Ark., to Waldron, and right of way is being secured.

Texas & Pacific.—A press report from El Paso, Tex., says that officials of this company are making arrangements for the construction of the Sierra Bianca Ry.

New Projects and Surveys.

Gulf, Houston & Rio Grande.—The Texas company has elected the following directors: P. W. SMITH, J. W. POTTER, Boston, Mass.; JOSIAH REIFF, New York City; J. W. SMITH, A. CROSS, S. PACKARD and J. L. MITCHELL, of Houston, Tex.

Texas & Northwestern.—Chartered in Texas by R. H. SELLERS, R. A. ROGERS and others of Sealy, to build a railroad from Ft. Worth to Albuquerque, N. M.

Louisiana, Arkansas & Missouri River.—This company has elected HARLOW M. HOYT, New York City, President; LOGAN H. ROOTS, Little Rock, Ark., Vice President; and C. R. MILLER, New York, Treasurer.

Ouachita Valley.—A contract for 50 miles of this Louisiana road, to be finished in 5 months, has been let to Burkett & Murphy, of Texas. FRANK P. STUBBS, of Monroe, La., is President.

Cape Girardeau & Grand Tower.—A meeting was held at Cape Girardeau, Mo., Dec. 15 and committes were appointed to secure right of way for a railroad from East Cape Girardeau to Grand Tower, Ill.

North Dallas.—This Texas company has been incorporated with a capital stock of $100,000.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Denver & Rio Grande.—Work has begun on the extension from Sapinero to Lake City, Col.—It is stated that the route of the Salt Lake City extension will be from Glenwood Springs to the mouth of Rifle creek, up that stream and across the divide to Pi-ce-ance creek, which will be followed to White river. From here the line will run up the White and Du Chesne rivers and Strawberry creek to a terminus at Springfield, near Provo, Utah. From here the D. & R. G. Western will be paralleled, if a trackage right cannot be secured.

Union Pacific.—Reports are still received of the work of the large surveying party locating a line near Redding, Cal.

Seattle & Northern.—This new Washington Territory company seems to be pushing things. They have given H. Mitchell a ten-mile contract east from Ship Harbor on Fidalgo Island, and will soon ask bids for 30 miles more up the Skagit valley.

Kansas City, El Paso & Mexican.—Work has stopped on this road, it is alleged for lack of funds. Ten miles of track have been laid, from El Paso to Lanoria, Tex.

Oregon & Washington Territory.—A bonus of $45,000 has been offered Mr. G. W. HUNT to extend this system to Dayton, Ore., *via* Waitsburg.

Park Railway of Denver.—

DENVER, Col., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:

The survey of this road is nearly completed and the contracts for construction let to Ballard & Weeks, the present projected distance of 3⅝ miles to be completed by Dec. 20, 1888. The work is easy with a maximum grade of 1¾ per cent. and curvature of 60°. It will connect for the present with the Denver cable lines and will carry passengers only. Good progress has been made in obtaining right of way and the road will be built by the company. The company was incorporated in August 1888. PETER O'BRIEN is chief Engineer. We will use the H. K. Porter & Co.' motor, and St. Louis Car Co.'s car. Will open the line for traffic on Jan. 1.

J. W. STRAYER, *Pres. & Gen. Man.*

New Projects and Surveys

Trinidad & Rocky Mountain.—This company has been chartered in Colorado to build a railroad from Trinidad to Las Vegas, N. M. Among the incorporators are WALLACE T. FOOTE, Jr., JOHN R. WEEKS and CHAS. F. BATES.

Bagdad & Matamoras.—It is stated that this Mexican project has been given up, the projectors failing to secure the expected concession.

Assiniboia, Edmonton & Unyega.—A charter is to be asked for a railway from Swift Current, on the Canadian Pacific in Assiniboia, northwest to the Peace river country.

Proposals Open.

Pumping Engines.—At the Chattanooga, Tenn., water-works, an engine of 8,000,000 galls. daily capacity; either compound condensing or high duty. Parties in a position to do so are requested to send bids for both classes of engines. Domestic pressure to be pumped against is 100 lbs., and must be capable of pumping against a pressure of 130 lbs.——For Keokuk, Ia., a compound condensing engine of 3,000,000 galls. daily capacity. Domestic pressure, 100 lbs., fire pressure 140 lbs. ——At Wichita, Kan., a compound condensing engine of 5,000,000 galls. daily capacity, capable of pumping against a domestic pressure of 60 lbs. and a fire pressure of 110 lbs. Proposals must include the erection and testing of the engine upon the foundations. The average steam pressure at each of the above works is about 70 lbs. W. S. KUHN, General Manager, American Water-Works & Guarantee Co., Pittsburg, Pa.

Sewers.—Salt glazed vitrified pipe, 12-in.; brick 30 x 45 ins., manholes, etc. ERNEST ADAM, City Surveyor, Newark, N. J. December 26.

Retaining Wall—Around the distributing reservoir on the county farm at St. Johnland, L. I. JAMES F. CAREY, engineer. THE COUNTY FARM COMMITTEE, Board of Supervisors of Kings Co., County Court House, Brooklyn, N. Y. December 27.

Pier Work.—Dumping board foundation at E. 17th St., East river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. December 27.

Dredging.—In the East river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. December 27.

Electric Lighting.—About 31 lights of 2,000 c. p.; poles to cover 6 miles; lights, 30 ft. from the ground; to be lit 250 or more nights per year. STEPHEN KING, Chairman of Fire, Water & Gas Committee, Ingersoll, Ont., Canada. December 27.

Street Lighting.—Gas or electricity; 200, 300 or 400 electric lights, or the number of gas lamps now in use. E. B. DAGGETT, Fort Worth, Tex. January 1.

Canal Work.—New York State canals. The following are the locations and descriptions of the different pieces of work and estimated quantities: No. 10. Rebuilding berme abutment and wooden bridge superstructure at bridge No. 131, Champlain canal. No. 11. Improving 1,550 ft. of the Glen's Falls feeder of Champlain canal, in Glen's Falls. Bailing and draining; 70 cu. yds. excavation old masonry; 4,300 cu. yds. excavation earth and vertical wall; 1,100 cu. yds. excavation of rock not requiring blasting; 6,000 cu. yds. excavation of rock requiring blasting; 2,400 cu. yds. embankment; 10 cu. yds. loose stone; 10 cu. yds. puddling; 4,350 cu. yds. procuring and puddling; 1,450 cu. yds. lining; 116 cu. yds. abutment masonry, including coping; 2,900 cu. yds. vertical wall in cement, including coping; 50 cu. yds. concrete.; 3,200 ft. B. M. hemlock timber and plank; 7,000 ft. B. M. white pine timber plank; 800 ft. B. M. white oak timber and plank; 1,200 pounds wrought-iron; 550 pounds cast-iron; 250 pounds spikes and nails; removing old bridge superstructure; painting bridge superstructure; deduct materials furnished by State; 10 cu. yds. loose stone at $1 per yd.; 50 cu. yds. backing at $2 per yd.; 2,000 cu. yds. vertical wall stone at $1 50 per yd. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. January 3.

Sea Wall.—Concrete wall, and stone and gravel backfilling. S. S. HARVEY, Key West, Fla. January 5.

Railway.—Franchise for electric or other railway from White Plains, N. Y., to Elmsford, on the New York & Northern Ry., 3 miles. THE BOARD OF VILLAGE TRUSTEES, White Plains, N. Y. January 7.

Bridges.—Three bridges. JOHN T. COOPER, Atlanta, Ga. January 8.

Armory.—On Ninth Ave. and 67th St. Masonry, carpenter work, iron work, plumbing and gas fitting, steam-heating and ventilating. THE ARMORY BOARD, Staats-Zeitung Building, New York City. January 14.

Water-Works Supplies.—Pipe, valves, stop-cocks, etc. THE BOARD OF WATER COMMISSIONERS, St. Paul, Minn. January 15.

Water-Works.—At Leetonia, O. Extension of time. About 5½ miles of 4 to 10-in. pipe, 55 hydrants, 60 gates, 60 gate boxes, pumping plant of 1,500,000 galls. daily capacity, pump house, pump well and reservoir. Engineer, J. B. STRAWN, C. E., Salem, O. Propositions on the franchise plan will be considered. J. S. GREENAMYER, Mayor, Leetonia, O. January 17.

GOVERNMENT WORK.

Jetty and Mattress Work.—Constructing a jetty of stone and oyster shells at the entrance to Cumberland Sound, Georgia and Florida. Amount available about $100,000.——Constructing a training wall at the mouth of the Savannah river, and depositing stone on the Fig Island training wall below the city of Savannah, Ga. Amount available about $120,000. Lieut. O. M. CARTER, U. S. Engineer Office, Savannah, Ga. December 24.

Harbor Work.—Improving harbor at Ludington, Mich. Placing about 17 cribs and building 135 lin. ft. of pile pier. For particulars apply to Lieut. Jos. E. KUHN, U. S. Engineer Office, Grand Rapids, Mich. Col. S. M. MANSFIELD, U. S. Engineer Office, Grand Rapids, Mich. December 31.

Shipbuilding Materials.—Materials for the construction of the U. S. monitor "Terror" at the Brooklyn navy yard. THE SECRETARY OF THE NAVY, Navy Department, Washington, D. C. January 7.

Dredging and Stone.—Dredging in Bogue Sound (inland waterway between Beaufort harbor and New river, N. C.); in New river, N. C.; in Beaufort harbor, N. C.; in Harlowe creek (inland waterway between New Berne and Beaufort, N. C.), and in Georgetown, S. C., harbor. Rubble stone at Beaufort harbor, N. C. Capt. W. H. BIXBY, U. S. Engineer Office, Wilmington, N. C. January 9.

Dredging.—In Maine: Moos-a-Bec bar; Back cove, Portland harbor; Lubec channel; Narragaugus river, and Rockport harbor; also in Bellamy river, N. H. Lieut. Col. JARED A. SMITH, U. S. Engineer Office, Portland, Me. January 10.

Water-Works.—At Fort Robinson, Neb. Extension of time. Not an extensive or costly system, but such as is required to supply a military post. Major W. B. HUGHES, U. S. A., Omaha, Neb. January 15.

Contracting.

Electric Lighting.—The city of Stoughton, Wis., is ready to consider propositions for establishing an electric light system. For particulars address B. E. WAIT, City Clerk.

Wells.—The Cook Well Co., of St. Louis, Mo., has a contract for a 7-in. tube well, with pump and outfit complete, for the Little Rock Oil & Compress Co. Also a contract for a 7-in. well with pump and outfit complete at Ashland, Neb.

Heating Apparatus.—The following proposals for the heating of 4 pavilions at North Brothers Id., have been received by the Health Dept., New York City: John Neal's Sons, $1,765; Baker, Smith & Co., $2,678; Rutzler & Blake, $3,787. The contract was awarded to John Neal's Sons.

Artesian Wells.—Major REILLY, U. S. A., has awarded the contract for sinking the well at the U. S. arsenal, Augusta, Ga., to Sparks & Allen, of Dundee, Mich., at $4.25 per ft. for the first 500 ft., and $2.75 per ft. for all below. The bids were given on page 457.

The Toledo Foundry & Machine Co., Toledo, O., has recently taken a contract to build a large and powerful steam dredge for Buffalo, N. Y., contractors who have extensive work under the Government for excavating rock. It will be one of the most powerful dredges on the lakes, being the first ever built having an iron hull. It will be completed by April 15, 1889, and will cost $20,000.

The Porter Mfg. Co., of Cleveland, O., issues an illustrated catalogue of different classes of engines, boilers, and hoisting engines; also the Brennan rock breaker. There are tables of weights of materials, diameters and circumferences of circles, etc. Pierce & Thomas, of Cortlandt St., are the New York agents of the company.

A Contractor's Work.—J. S. Antonelle, of San Francisco, Cal., has the contract for the completion of Section No. 8 of the seawall, and for other work at that city. He also has a contract on the water-works at Findlay, O. Mr. Antonelle did considerable railway and other public works construction in Europe, and came to this country in 1871, where he has had contracts on the Welland canal, on the West Shore, N. Y. Central and other eastern railways and on the Canadian Pacific and Esquimault & Nanaimo roads in the west. He has also had a contract for the Spring Valley Water-Works Co., of San Francisco.

New Croton Aqueduct.—The Aqueduct Commissioners on Dec. 19 awarded to David R. Paige & Co. the contract for the construction of two dams at South East, Putnam Co., N. Y. The contract price was $451,750; the engineer's estimate was $510,430.

Government Work.—***Breakwaters.***—The following proposals were opened Dec. 13 by Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City: At New Haven, Conn.; 30,000 tons; J. Beattie, $1.22 per ton: F. H. Smith, $1.45.——At Port Chester, N. Y.; 3,400 tons; S. & E. S. Belden, $1.19 per ton; J. A. Bouker, $1.23; J. Beattie, $1.40; F. H. Smith, $1.45; J. R. Howell, $1.65.——At Greenport, N. Y.; 3,400 tons; W. H. Molthrop & Co., $1.23 per ton; J. V. Luce, $1.32; Jno. Beattie, $1.35; F. H. Smith, $1.45; J. A. Bouker, $1.47.——Extending dike in New Haven harbor, Conn.; 10,000 tons; Jno. Beattie, $1.16; Chas. H. Edwards, $1.19; S. & E. S. Belden, $1.21; Jno. A. Bouker, $1.35; F. H. Smith, $1.43; James V. Luce, $1.52; W. H. Molthrop, $1.55.

Breakwater.—The following proposals for building breakwater in San Luis Obispo harbor, Cal., were opened Dec. 6 by Major W. H. H. BENYAURD, U. S. Engineer Office, San Francisco, Cal.: Rudolf Axman, San Diego, $3.44 per ton; American Bridge & Building Co., San Francisco, Cal., $3.45: San Francisco Bridge Co., San Francisco, Cal., $3.69.

Harbor Work.—The following proposals for improving the entrance to Humboldt bay have been received by Major W. H. HEUER, U.S. Engineer Office, San Francisco, Cal.: American Bridge & Building Co., San Francisco, $2 per ton for rock in place, $1.85 per cu. yd. for brush mattress, $5.50 per ft. for pier with track over water, $2.75 per ft. for roadway and trackway on shore; Chas. A. Hooper, San Francisco, $2.50, $2.09, $5,99, $2.90; Louisiana Jetty & Lighterage Co., New Orleans, La., $3.15, $2, $4.50, $3; James Simpson, Eureka, Cal., $2.90, $2.45, $6, $4; San Francisco Bridge Co., San Francisco, Cal., $2.95, $2.30, $6, $5; John W. Ferris, Stockton, Cal., $4, $2, $6, $3.

Breakwater.—The following proposals for constructing a breakwater at Gordon's Landing, Vt., were opened Dec. 13, by Major M. B. ADAMS, U. S. Engineer Office, Burington, Vt.: Willard Johnson, Fulton, N. Y.; 6,367 cu. yds. of rubble stone in place, 90 cts. per cu. yd.; 1,756 cu. yds. of large stone in place, $2.90 per cu. yd.; 57 lbs. of ring bolts in place, 10 cts. per lb.; total, $10,828.40. Nelson W. Fisk, Isle la Motte, Vt.; 92 cts., $3.12, 10 cts., $11,342.06; South Hess Stone Co., St. Albans, Vt.; 95 cts., $4, 8 cts., $13,077.21. Vermont Construction Co., St. Albans, Vt.; 98 cts., $5, 10 cts., $15,025.36. James Franklin & Godtschalk Olson, Buffalo, N. Y.; $2, $4 10 cts., $19,763.70.

Sioux City Foundry & Machine Works.—Among recent sales are two 75 H. P. Corliss engines for the Pioneer Press Building at St. Paul, Minn.; also two 75 H. P. Corliss engines for electric lighting purposes, one for James Bell, David City, Neb., and the other for the Storm Lake Electric Lighting Co., Storm Lake, Ia. These consist of complete steam plants. A 10 x 16 Giddings, single valve automatic engine has been sold, together with a boiler, to the Chillicothe Water, Gas & Electric Light Co., Chillicothe, Mo. A full line of sizes of this engine known in the East as the "Russell" automatic, is being manufactured. The works are being improved and a 90-in. fly wheel lathe is being put in, also an overhead traveling crane, 30 ft. span and 7 tons capacity. The foundry department is working overtime in order to get out the engine work, in addition to the large orders for architectural iron work. Business is good, and a good winter trade is expected.

Dredging.—The following proposals were opened Dec. 13, by Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City:—At Wilson's point, Norwalk harbor, Conn.; 140,000 cu. yds.; A. J. Beardsley, 11 cts. per cu. yd.; P. Sanford Ross, 15 cts.; J. H. Fenner, 17 cts.; Hartford Dredging Co., 18 cts.; E. Brainard, 19¼ cts.——In Thames river, below Allyn's point, Conn.; 80,000 cu. yds.; Elijah Brainard, 18.9 cts. per cu. yd.; Hartford Dredging Co., 23 cts.; P. Sanford Ross, 25 cts.; Morris & Cummings Dredging Co., 27 cts.——In Thames river, above Allyn's point, Conn., 80,000 cu. yds.: Hartford Dredging Co., 15.7 cts. per cu. yd.; J. H. Fenner, 18 cts.; E. Brainard, 21 cts.; Morris & Cummings Dredging Co., 23 cts.——In Norwalk river, Conn.; 12,000 cu. yds.; A. J. Beardsley, 15 cts. per cu. yd.; Hartford Dredging Co., 16½ cts.; E. Brainard, 21 cts.——In Bridgeport harbor, Conn.; 40,000 cu. yds.; A. J. Beardsley, 18 cts. per cu. yd.; Hartford Dredging Co., 23½ cts.; E. Brainard, 26 cts.——In Stamford harbor, Conn.; 20,000 cu. yds.; Hartford Dredging Co., 18 cts. per cu. yd.; A. J. Beardsley, 24 cts.; J. H. Fenner, 24½ cts.; H. E. DuBois, 29½ cts.——In Milford harbor, Conn.; 18,000 cu. yds.; Hartford Dredging Co., 18 cts. per cu. yd.; Jno. H. Fenner, 20 cts.——In Five-Mile River harbor, Conn.; 20,000 cu. yds.; Hartford Dredging Co., 33 cts. per cu. yd.

The following proposals for dredging about 50,000 cu. yds. of gravel, disintegrated rock and solid rock from Stearn's Dyke cut in the channel of the James river about 1 mile below Richmond, and depositing the material on wing dams and training walls, average cut 3 ft., were opened Dec. 11 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va.: American Dredging Co., Philadelphia, Pa., $1.50 per cu. yd., $75,000; O. J. Jennings, Fulton, N. Y., $1.65, $82,500; Alabama Dredging & Jetty Co., Mobile, Ala., $3.80, $190,000. The prices were considered too high and all the bids were rejected.

Dams.—The contract for rebuilding the dam at Big Rapids, Mich., which was washed away recently, has been awarded to John F. Byers.——The contract for the new dam across the Aroostook river at Caribou, Me., has been awarded to T. J. Emery, of Waterville, who has contracted with S. W. Collins & Son, of Caribou for 180,000 ft. of birch, cedar and hemlock, and with E. E. Parkhurst of Maysville, for 100,000 ft. of hemlock.

Cleaning Sewers.—The following proposals for cleaning the sewers and receiving basins during the fiscal year beginning Dec. 1, 1888, have been received by the Board of Public Works, Jersey City, N. J.: Geo. C. Rose; 2 cts. per lin. ft. for main sewers, 1¾ cts. per lin. ft. for lateral sewers, $1.50 each for receiving basins; John H. Keeney, 4 cts., 2½ cts., $1.70; Denis Byrn s, 4 cts., 4 cts., $1.75. The contract was awarded to Denis Byrnes.

The Barr Pumping Engine Co. is building hydraulic pressure pumps of the following dimensions for the firms named below: One 26 by 9 by 36 for Jones, Langhlin & Co., Pittsburg, Pa.; one 18 by 5½ by 18 for Henry Warden, Philadelphia, Pa. Business in trade pumps as well as special work is rapidly increasing with this company and it has enlarged the plant and working force to meet the growing demand. For the convenience of Western customers the company has established a branch office, at No. 35 5th Ave., Chicago, with Messrs. Baze & Davis as managers.

Dam and Tunnel.—The following proposals for building a dam to form a reservoir on the Byram river, and for building a tunnel and channelway to convey the waters of the river into the Kensico reservoir in the town of North Castle, Westchester Co., were opened at the Department of Public Works, New York City, Dec. 13: John McQuade, $309,155; J. R. Page, $235,830; V. Del Genovese, $236,634.80; Sullivan & Pallino, $299,800; John Duffy, $250,600; F. Thileman, Jr., $276,000; Coleman, Smith & Brown, $362,670; J. Curran & Co., $381,240. The engineer's estimate was $240,050.

Dredging.—The following proposals were opened Dec. 10, 1888 by S. T. ABERT, U. S. Engineer Office, Washington, D. C.: In channel at Mt. Vernon; Frank C. Somers, Camden, N. J., 11¾ cts. per cu. yd.; Atlas Dredging Co., Wilmington, Del., 12.9 cts.; Chester F. Caler, Norfolk, Va., 13¾ cts.; American Dredging Co., Philadelphia, Pa., 15 cts In York river, Va.; American Dredging Co., 12 cts.; Geo. C. Fobes & Co., Baltimore, Md., 12.3 cts.; Atlas Dredging Co., 13 cts.

The following proposal for dredging in the Appomattox river, Va., was opened Dec. 4 by Lieut. G. J. FIEBEGER, U. S. Engineer Office, Norfolk, Va.: Geo. E. Ward, Richmond, Va., 30 cts. per cu. yd.

Bridge.—The following proposals for building a stone pier and stone abutment, with wings, for the Wardsville bridge, also for building an iron superstructure with one span of 180 ft. and one of 50 ft., were opened Dec. 6 by the County Commissioner, London, Ont.; JAS. A. BELL, St. Thomas, Ont., is County Engineer: Substructure; English & Crouse, $11.75 per cu. yd. for stone work; $4.75 per cu. yd. for concrete; Geo. Heard & Co., $11.50, $7.50; Hock & Babcock, $13.25, $4.50; E. & C. Farquhar, $14, $5; John Elliott, $14, $5.75; Essen & Fallows, $15.25, $6. The contract was awarded to English & Crouse. The work consists of 934 cu. yds. of masonry, and 188 cu. yds. of concrete.——Superstructure: Central Bridge Works, Peterborough, $5,670; Kincardine Bridge Co., Kincardine, $5,740; Hamilton Bridge Co., Hamilton, $6,401.75; Weddell Bridge Co., Lachine, $6,846; Dominion Bridge Co., Montreal $7,000. The contract was awarded to the Central Bridge Co.

Metal Markets.—***Structural Iron.***—Prices are about as follows: in Philadelphia: 2c. @ 2.10c. for bridge plate; 2c. @ 2.10 c. for angles; 2.6c. @ 2.7c. for tees, and 3.3c. for beams and channels, iron or steel. New York prices are: sheared plates, 2c. @ 2.1c.; universal mill plates, 2.1c. @ 2.2c.; angles, 2c. @ 2.10c.; tees, 2.5c. @ 2.6c., channels and beams, 2.55c. @ 2.75c.

Steel Rails.—Pittsburgh, $28. Considerable stir has been created by the report in the newspapers that the Chicago Rolling Mill Co. had taken an order for 17,000 tons for the Union Pacific at a price equivalent to $27.50 at Chicago. This is the order secured first by the Carnegie firm, at Pittsburg, at $30, plus bridge toll, delivered at Omaha. For a consideration, this mill transferred the work to the Chicago concern, partly because the former found it somewhat difficult to arrange for the delivery required. The opinion is expressed, too, that the transfer implied the withdrawal from competition on some business now pending. Negotiations are under way for some important orders, with the probability that they will be closed before the new year. Buyers have been holding off, in distrust of the stability of the higher prices now being asked by the mills.

Railway Track Supplies.—Pittsburg, Pa.; spikes, $2.15, 30 days, delivered; splice bars, $1.85 @ $ 1.90; track bolts, $2.85 with square, and $2.95 with hexagon nuts.

Old Material.—Pittsburg, Pa.; No. 1 wrought scrap, $21, net ton; wrought turnings, $13 @ $14; car axles, $25 @ $26; cast scrap, $15.25 @ $15.50, gross ton; cast borings, $12 @ $13; old car wheels, $20. Short pieces of old steel rails at $18.50 @ $19. Old rails, $20.50 @ $21 in Pittsburg. Rail ends, $19 @ $19.50. (Compiled from *Iron Age*, Dec. 20).

The Safety Water Column, manufactured by the Reliance Gauge Co., of Cleveland, O., received the highest award, a silver medal, at the Cincinnati exposition.

Boring.—The contract for prospecting work for the new Merchant's bridge at Chain of Rocks, St. Louis, Mo., has been awarded to the Cook Well Co., which is now at work.

Street Sprinkling.—At Lancaster, Pa., bids were opened Dec. 5, by JACOB HALBACH, Clerk of the Water Commissioners, for the use of the city water for street sprinkling purposes for the year commencing April 1, 1889. Two bids were received: Enos. H. Weaver, $326 per annum for each 2-horse sprinkler, and $201 for each 1-horse sprinkler: Daniel Nein, $325.50 and $175 per annum. The contract was awarded to Enos. H. Weaver.

Bridges. — ***Pineville, Ky.***—The Louisville Bridge Co., of Louisville, Ky., has the contract for a 135 ft. bridge over Straight creek.

Manatee, Fla. — Contracts have been awarded to H. Wadhan, for the Frog creek and McMillin bridges, and to J. M. DePew for the Braden river bridge.

Indianapolis, Ind.—The County Commissioners have let the contract for the superstructure of the bridge over Pleasant run, on the Harmony free gravel road, to the Pittsburg Bridge Co., of Pittsburg, Pa. The masonry contract was let to Ross & Fritz. The total cost of the bridge will be about $40,000.

Omaha, Neb. — The Milwaukee Bridge Co., of Milwaukee, Wis., has the contract for a bridge over Indian creek at Broadway; it will be 60 ft. long and 60 ft. wide. The contract price is $7,750.

Choteau, Mont.—The contract for the two iron bridges across the Teton has been let to the Massillon Bridge Co., of Massillon, O. The two bridges are to cost $10,331, with approaches and everything complete ready for use. One bridge will be placed near the the town of Choteau and the other at some crossing of the stream lower down.

Street Lighting.—***Pittsburg, Pa.***—The following proposals have been received by the Department of Awards for the lighting of the South Side, East End and West End for the next 3 years. Booth & Flinn, bid $17.39 per lamp with gasoline. The Wheeler Reflecting System bid $14.98 per lamp per annum for oil and $15.98 for gasoline. The South Side Gas Co., bidding for the South Side district, asked $18.60 per lamp for gas or gasoline. The Pennsylvania Globe Gas Lighting Co., bid $16.91, the lighting to be in accordance with the system now in use.

The Fort Wayne Jenney Electric Light Co. proposed to furnish 500 lights of 2,000 c. p at $105 each per year; 300 lights or less, of the same power, at $127 each; incandescent lights of 25 c. p. $16.50 each, and the same light of 16-c. p., $11.50 each; gasoline lamps at $18.85. The East End Light Co. bid $120 per lamp for 100 arc lights of 2,000-c. p. each, all in excess of 100 lights to be furnished at $100 per year each. Incandescent lamps of 25-c. p. would be $16 per lamp, and the same of 16-c. p. $12 per lamp. In districts their lines did not reach they would use gasoline at $12 per light. It is said that Martin Joyce, a well known contractor had prepared a bid of $11.30 per light; he started up the City Hall steps about 2 o'clock, at which hour the bids closed, with the bid in his pocket. On the steps he met a member of the Street Department, with whom he spent several minutes in conversation, and when he reached the Controller's office he found he was just seven minutes too late to file his bid.

Sewers.—***Albany, N. Y.***—The following proposals have been received by the Board of Contract: Patrick H. Reilly, $2.25 for 15-in. pipe, $4.50 for Y branches, $70 for manholes; Wm. E. Murphy, $2.50, $6, $65; Patrick Murray, $4.95, $5.40, $75. The contract was awarded to P. H. Reilly.

Jersey City, N. J.—The following proposals for reconstructing sewer in 13th St. have been received by the Board of Public Works: Thomas Kelly, $6 per lin. ft. for rebuilding 60-in. sewer, $7 per lin. ft. for new 60-in. sewer, $4 per cu. yd. for stone masonry; Michael Mullery, $5, $7.50, $1; John H. Keeney, $4, $11, $1.50.

Fort Scott, Kan.—The following is the City Engineer's report of final estimates of work done on Sewer Dist. No. 3: 2,596 ft. of main sewer at $1.40, $3,634.40; 807 ft, No. 1 lateral, $1.50, $1,213.50; 1,759 ft. No. 2 lateral, $1.65, $2,902.35; 1,352 ft. No. 3 lateral, $1.45, $1,960.40; 1,059 ft. No. 4 lateral, $1.50, $1,588.50; 3.65 cu. yds. masonry outlet $2, $7.30; 35.13 cu. yds. manhole, $3.50, $123.13; 704 lbs. castings, $1.05, $35.30; total, $11,464.78. The sewers in this district have been completed.

Los Angeles, Cal.—The contract for a storm water drain on 5th St. has been awarded to Frick Bros. at 66 cts. per ft. for the pipe, 45 cts. per cu. yd. for excavating, $24 for each catch basin.

Street Work.—***Lowell, Mass.***—The committee on finance has authorized the city treasurer to borrow $20,000 for street purposes.

Brooklyn, N. Y.—The Department of City Works has received bids for flagging sidewalks at 22¼ to 24 cts. per sq. ft.; and for fencing lots at 57 to 65 cts. per lin. ft.

Albany, N. Y.—The Board of Contract has awarded to P. H. Reilly the contract for grading the public market site, at 40 cts. per cu. yd. for excavating, and $150 for each driveway.

Helena, Mont.—The contract for grading Benton Ave. has been awarded to Wm. F. Bryant, at 40 cts. per cu. yd. for earth, and 75 cts. per solid rock.

Los Angeles, Cal.—Contracts have been awarded as follows: W. R. Porter, 26 cts. per sq. ft. for bituminous rock paving on broken rock base, $1.20 per lin. ft. for granite curbing; M. C. Marsh, $1.88 per lin. ft. for redwood curbing; Gray Bros., 13¾ cts. per sq. ft. for cement sidewalk, 42 cts. per lin. ft. for artificial stone curbing; Alex. Dallas, $1.95 per lin. ft. for redwood curbing.

Alameda, Cal.—The Supervisors have received bids as follows: Alameda Macadamizing Co., 7½ and 7¾ cts. per sq. ft. for macadamizing, 12½ cts. per lin. ft. for curbing, $1 per lin. ft. for culverts, 65 cts. per lin. ft. for crosswalks; Oakland Paving Co., 7 cts. per sq. ft for macadamizing roadway, ½ ct. per sq. ft. for grading street and sidewalk, 12 cts. per cu. yd. for curbing, $1 per lin. ft. for culverts with crosswalks.

WATER.

Drainage in Illinois.—J. A. BENTLY, of Monticello, Ill., has been elected Commissioner of the Lake Park drainage district. The work has cost the counties of Piatt, Champaign and Douglas over $200,000, and it has been voted to continue the work until all the low lands are restored.

Oil Pipe Line.—The Standard Oil Co. contemplates the construction of another big pipe line from Lima, O.; St. Louis, Mo., being the objective point. It is the intention of the company to build a line about the size of the line to Chicago for the purpose of transporting oil for both illuminating and fuel purposes to St. Louis, to be distributed from that city to the Southern and Southwestern States. The new line will be a little longer than the Chicago line and have more relay stations. The company has representatives at work securing the right of way, and active work will be commenced on the line early in the spring.

A Flowing Well.—The following is the text of a press despatch of Dec. 5, from Waterloo, Ia.:

"A few mornings ago J. J. COOK, living a short distance from Tripoli, Bremer County, was awakened by a roaring noise. On investigation he found that the water was pouring out of the top of a well recently drilled on his premises, in a torrent. The water is still flowing at the rate of about 15 barrels per minute, and the well is considered nearly as much of a gusher as the one at Belle Plaine. There are no other flowing wells in that locality. Reports state that the water rises about 6 ft. above the top of the well, and that the outpour is estimated at 8 barrels per minute. The owner of the gusher is endeavoring to confine the water in pipes, but thus far has not been successful."

Memphis, Tenn.—There has been some complaint recently about muddy water supplied by the Artesian Water Co., and it was thought that the company was letting in some water from the muddy Wolf river with the artesian well water. Superintendent W. L. CAMERON, however, stated to a reporter that the dirty appearance of the water was caused by the crust of rust in the mains, which is the formation of years and is now being loosened by the high pressure. Work is progressing on the steel stand-pipe, which will be 100 ft. high and 24 ft. diameter. A large dry well, 90 ft. deep and 38 ft. in diameter, lined with brick in cement, is being dng for the 4 Worthington pumps of 10,000,000 galls. capacity; M. Philbin is the contractor for this work. The company has lately completed its main pipe system, consisting of over 9,000 ft. of 36-in. pipe, 17,000 ft. of 24-in., 700 ft. of 30-in., 9,700 ft. of 20-in., 15,000 ft. of 16-in., 9,500 ft. of 12-in. and 21,000 ft. of 10-in. and some 40 miles of 8-in., 6-in. and 4-in. pipe. There is to be added about 10 miles of 12-in., 10-in., 8-in. and 6-in. pipe during the next three months. The construction of the pipe system is under the supervision of the superintendent of the company, W. L. CAMERON, and the other work under the supervision of THOMAS T. JOHNSTON, C. E., of Chicago, Ill.

Los Angeles, Cal.—J. DALY, who is City Attorney, has made a proposition to establish a system of sewerage. There will be an outfall sewer from the southern city boundary to the ocean or to a sewage farm. The work to be completed in 90 days after commencement. Work to begin at once. If the West system is adopted the system will be built to the company's works, or if it is not adopted then an outfall will be built to the ocean, not to the shore, but out into high water. The backers of the enterprise would furnish land for a sewage farm, or, if the city desires to furnish the land, they will deliver the sewage there, or will agree, in case the sewage farm does not work satisfatorily, to build the outfall. All lateral sewers to be assessed pro rata upon the property fronting thereon, as by law provided. All intercepting main and branch main sewers to be assessed upon all lands affected or benefited thereby, as by the general law provided; but said assessment not to be paid until the property assessed is reached in the construction of the system and connection therewith made available by the construction and completion of the sewers in the assessment section of the work, within which the property assessed is situated. The price to be paid to be determined by the Council and other party, and fixed at a maximum price or sum per lineal foot, within each assessment district.

Water-Works.—***Massachusetts.***—Springfield. The Water Commissioners, in a report to the Board of Aldermen, have again urged the laying of an additional main to the Ludlow reservoir, as recommended by them in 1884. The present main is 24 ins. diameter and the new one should be 36 ins. The number of water takers on the high service line in July, 1884, was 1,416; there are now 2,300, an increase of 884, each additional service representing a consumption of about 800 galls. a day, or an increase in consumption during this period of about 727,000 galls. a day on the high service line alone. There have been added to both the high and low service during the same time about 1,083 new services representing an increase in consumption of about 1,346,000 galls. a day. To this large increase in consumption may be attributed the decrease in pressure which furnishes the grounds for the numerous complaints made to the department.

Connecticut.—Stonington. The reservoir for the new water supply has been completed.

New York.—Fort Niagara. W. Ripson & Son have the contract for extending the water-works.

New Jersey. — Newark. The Board of Trade has adopted resolutions urging the procuring of a new water supply by the city, but protesting, by an almost unanimous vote, against letting the contract to private parties. One of the Newark Aqueduct Commissioners is authority for a statement that the board has decided to contract with JULIUS H. PRATT for a supply of water from the Pequannock river, the city to buy the plant at its completion for a sum not to exceed $4,000,000. The announcement has created widespread interest in Newark. Mayor HAYNES is quoted as having said that the making of the contract shuts out the Bartlett syndicate.

Pennsylvania.—Sharon. The Sharon Water Co. has elected H. S. HOPPER, of Philadelphia, President; and WALTER WOOD, of Philadelphia, Secretary, to succeed SAMUEL R. BULLOCK and W. S. MERCER respectively. ——Lancaster. The new pumping engine of 6,000,000 galls. daily capacity has been erected.

Virginia.—Pulaski City. The Swansea Land & Improvement Co. will soon commence work on the water-works. The supply will probably be obtained from artesian wells.

Tennessee.—Cleveland. Address the Mayor for particulars as to the new water-works.—— Athens. The water-works are completed; the supply is pumped from springs by a 40 H. P. engine to a stand-pipe of 60,000 galls. capacity.

Kentucky.—Mt. Sterling. There is some talk of building water-works. H. CLAY MCKEE is Chairman of the Committee on Water-Works. —— Harrodsburg. The Harrodsburg Water Co. has been incorporated by G. H. GAITHER and others. Capital stock, $100,000.

Georgia.—Washington. It is proposed to issue bonds to build water-works. The water will be pumped to a stand-pipe. For particulars address W. A. BENSON.—— Cedartown. J. W. MEED, of New York, is interested in a water-works project.

Florida.—Key West. The Key West Water Co. will resume its drilling for a water supply.

Alabama.—Mobile. Contracts have been let for constructing a system of water-works at the Spring Hill College, to cost about $4,590. J. T. Palmer has the contract for the pipe and plumbing work.

Mississippi.—Greenville. The water-works have been completed. The wells were put down by the Cook Well Co., of St. Louis, Mo.

Michigan.—Marshall. The Marshall Water-Works Co. has been incorporated by THOMAS ROLLINSON and others. Capital stock, $100,000.

Illinois.—Minonk. The pump well and reservoir are finished, and the steam pump has been put in position.—— Pekin.—The extension of the water mains is completed.

Minnesota.—St. Paul. The Water Commissioners have decided to make the following suburban extensions: McAlister, 2 miles 3,940 ft., $29,500; St. Anthony Park, 8 miles 1,980 ft., $79,210; Warrendale, 2½ miles, $23,700; Hamline, 3 miles 910 ft., $28,250. In addition to these extensions there will be 18 miles of extensions for city property, making the total extensions for next year 34½ miles, and expense $308,460. The contract for supplying hydrants was awarded to R. D. Wood & Co., of Philadelphia, $12,000. The secretary was authorized to advertise for pipes, valves, stop-cocks, etc., the bids to be received up to Jan. 15.

Montana.—Helena. The water from the Woolston well has been analysed and pronounced to be of good quality for domestic purposes.

Arkansas.—Camden. The Camden Water-Works Co. has awarded the contract to build its works, to J. Walker Bates & Co., of New York. The cost will be about $20,000. The company will also erect an electric light plant.

Nebraska.—Columbus. A contract has been let for the extension of the water-works.——Lincoln. The Antelope well is now 42 ft. deep and is still yielding an abundant flow. The Water Commissioner, J. LYMAN believes in this as the future source of supply for the city.

Wyoming.—Green River. The Green River Water Co has been incorporated by CHARLES F. ADAMS and others. Capital stock, $250,000.

California.—Gilroy. The City Council has ordered an

election for Jan. 30 to decide on the proposition to issue bonds for $50,000 for placing the water system in perfect condition.——Rialto. The Semi-Tropic Land & Water Co. has awarded to Lukin & Sherer, of Los Angeles, the contract for laying cast-iron pipe for a water supply.

Texas.—Cuero. There are no water-works, but efforts are being made to have a system established. For further information address D. H. HEATON.

Canada.—St. Sauveur, Que. The water-works by-law has been rejected by a vote of 473 to 124.

Hartford, Conn.—The West Hartford reservoirs hold 700,000,000 galls., and that at Farmington holds over 600,000,000, a total of over 1,300,000,000 galls.

New Brunswick, N. J.—The water supply was cut off for some hours on Dec. 15 by the main leading from the eastern reservoir to the city becoming choked with ice, thus shutting off nearly one-half of the city. The watchman who should have looked after the main had gone off duty the night before and the trouble occurred during his absence.

Natural Gas.—At a meeting of the stockholders of the Philadelphia Natural Gas Co. on Dec. 5, a resolution was adopted authorizing the issue of $2,500,000 bonds to be used in the extension of the plant. The liabilities of the company are $1,300,000, and it is the intention to issue $1,500,000 of the bonds immediately to pay off this debt. The other million will be held in reserve. Nearly the entire capital stock of $7,500,000 was represented.

Troy, N. Y.—Superintendent BAERMANN has made a report to the Water Board on the meter system of supplying water. He recommends a resolution providing that all laterals connected with the city mains, using supplies for other than domestic purposes, shall be metered and charged for the quantity used at the uniform rate of 10 cts. for 1,000 galls. He says that water was furnished last year at the rate of 8,000,000 galls. a day at a cost of $49.24 for 1,000,000 galls. The receipts were $77,649, making the rate $25.88 per 1,000,000 galls. The superintendent thinks that the charge should be in relation to the amount consumed.

Chattanooga, Tenn.—The City Water Co. has concluded contracts with the Mission Ridge and East End land companies for the exclusive right to furnish water to those two suburbs, the contract binding for five years; 8-in. and 10-in. pipes are being laid; the mains have already been completed to Ridgedale and a force of 400 hands has been put to work extending the same to East Lake and East End. The company intends ultimately to build a reservoir on the side of Missionary ridge, which will enable it to supply water without drawing from the city resources. The Spring Lake Water Co. states that it will build works; the reservoir will be located on Missionary ridge at an altitude of 411 ft., giving sufficient pressure in the town to throw a stream 150 ft. high, and thus render steam fire engines unnecessary. The supply comes from a lake of nine acres, with an overflow of 5,000,000 galls. per 24 hours. The company proposes to lay 50 miles of pipe.

Drainage in Illinois.—The towns of Tuscola, Arcola and Bowdre are excited over the project to construct a canal, 14 miles long, to drain the lowlands of Douglas Co. The canal, which is to be built in the spring, with steam dredges, begins 1 mile northwest of Tuscola and runs southeasterly through Arcola and Bowdre, a portion of the way following the bed of a sluggish stream known as Scattering Fork. While the canal would be of great benefit to the section through which it runs, and would reclaim and make valuable probably 100,000 acres of lowlands, the majority of the farmers will bitterly oppose the scheme. The canal and its laterals will aggregate about 200 miles, and will cost the farmers and land owners, it is estimated, from $200,000 to $250,000. The assessments in some instances will run as high as $15 per acre, and as many farmers already have incumbrances on their land the project will cause them to dispose of them at a sacrifice. Construction is to begin next spring, but the property owners who oppose the scheme will use efforts to prevent its completion.

Minneapolis, Minn.—The new North Side pumping station has been completed. It is of red brick, and contains four large rooms besides the offices, and the sleeping apartment. The coal room is 72 x 36 ft., the boiler room, 84x44; the machine shop, 20 x 30, and the engine and pump room, 60 x 118 ft. The smokestack is 142 ft. high. The work was done by the day instead of by contract. Quicksand predominates in that locality, and to ensure a solid foundation it was necessary to go down 15 ft., at which depth sandstone rock was struck. In building the intake pipe, much trouble was found with this sand; on one occasion the whole crib was filled up by a big cave-in from the sides, and the pumping engine nearly buried out of sight. The whole job will cost the city very nearly $60,000, which is somewhat more than the contract price of the lowest bidder. Bridge Engineer F. W. CAPPELEN has had entire supervision of the construction. The intake pipe extends from the building 250 ft. out toward and into the river; it is constructed of brick and is 5 ft. in diameter. The outer end is 11 ft. below low water mark. A separate electric light plant will be placed in the building. There will be only one dynamo at the start, but the plant is arranged for two if necessary. The pumping plant will consist of two Worthington high duty pumps with a daily capacity of 15,000,000 galls. each; steam will be supplied by 6 boilers. The contract with the Worthington Co. amounts to $129,000. One pump will be put in place first, and the work of supplying the city begun as soon as it is ready. A 36-in. main leads from the station to 2nd St. and thence to 20th Ave. north, where it connects with the present city system. At 20th Ave. north a 24-in. submerged pipe crosses the river and is thus connected with the East side system.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

HUNTINGBURGH, Ind., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—The Citizens' Gas & Water Co. has been incorporated and expects to build works in the summer of 1889. Our population is now fully 3,000. Water will be pumped from Patoka river, which is 2½ miles distant; to a reservoir on a hill on the edge of the town, at an elevation of 100 ft. The estimated cost of the works is $40,000, and $20,000 has already been subscribed by citizens. C. W. SWARTZ is Secretary of the company.

HERMAN ROATHERT, *President.*

In addition to the works built by the Michigan Pipe Co., and described in our last issue, we have received from them a description of a system completed in November at Plymouth, Ind. The Mayor of that place Jos. SWINDELL, has also given us a report concerning these works. We give below the main facts from each report.

Plymouth, Ind.—The supply is furnished by four 5-in. driven wells, water from which flows to a pump-well, and is delivered directly to the mains by a 1,500,000 gall. Holly-Gaskill pump. There are 3¼ miles of 4 to 10-in. Wyckoff mains, and 30 Holly-Gaskill hydrants. Galvin valves are used, and the pressure ranges from 40 to 120 lbs. The works have cost $17,800, and $16,000 of bonds have been issued at 5 per cent. The principal contractors were the Michigan Pipe Co., Bay City, Mich. The contractors for buildings and pump well were Price & Stamburg, and for the driven wells, McAdams & Co.; both of Plymouth. The population is about 3,000.

PONTIAC, Mich., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:—Works were put in operation by the village Nov. 15. They were designed by J. D. COOK, Toledo, O., and built under the direction of HARVEY G. MONROE, who now acts as Superintendent. The contractors for the entire works were W. S. Parker & Co., New York City, who bought pipe of the New Philadelphia (O.) Pipe Works Co. The supply is by direct pumping from Clinton river, and wells. There are two compound duplex non-condensing Worthington pumps, each having a capacity of 1,500,000 galls. There are 13 miles of 4 to 16-in. cast-iron mains, and the services are of lead and iron. Already 30 taps have been made, and 114 Mathews hydrants set, the latter being furnished by R. D. Wood & Co., Philadelphia, Pa. Ludlow valves are used. The pressure is from 40 to 100 lbs. The works have cost $85,000, which has been met by 4½ per cent. bonds. The population is estimated to be 7,000.

JNO. D. NORTON, *Chairman of Comrs.*

FITZPATRICK, Ala., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—The Central Railroad & Banking Co. of Georgia, has put down an artesian well here. Water from it is used for domestic purposes, and the company has spoken of putting in two hydrants.

C. A. SHEALLY.

PINCKNEYVILLE, Ill., Dec. 14, 1888.

EDITOR ENGINEERING NEWS:—We are just getting a good start with our water-works. A dam to form a reservoir is being built. The village will own the works, but the extent of the system has not been decided, except that about $8,000 will be spent. There will be a debt of $6,000 at 6 per cent. J. L. MURPHY is Mayor. Population, 1,000. E. C. HAYES.

STAUNTON, Ill., Dec. 12, 1888.

EDITOR ENGINEERING NEWS:—The village is building a dam, with C. A. Tuttle & Sons, Decatur, Ill., as contractors. We are not able to raise enough money to put in complete water-works at once, but expect to add mains and pumping machinery as soon as arrangements for money can be made. The dam was designed by LEWIS STOCKETT, St. Louis, Mo., and will form a reservoir with an area of 20 acres, and a capacity of 90,000,000 galls. The dam will cost $12,200, and there will be a debt of $6,000 at 7 per cent. Our population is about 2,400. J. C. PARKHURST.

CHEROKEE, Ia., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—Our population is about 3,500, and we propose to put in a Holly system of water-works. A vote to bond the town will soon be taken. The works are estimated to cost $250,00. J. C. HALL is chairman of the water-works board.

FORT VALLEY, Ga., Dec. 14, 1888.

EDITOR ENGINEERING NEWS:—I am sorry to say we have no water-works, but we need them very much. I think works would be a good investment for some one.

J. D. MARSHALL.

OBERLIN, Kan., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—Water-works will be put in operation by the village Jan. 1, 1889. The supply is to be pumped from 32 tube wells to a stand-pipe 12 ft. in diameter and 100 ft. high, with a capacity of 84,000 galls. A duplex 3,000,000-gall. Gordon pump has been bought. There will be 2¾ miles of 4 to 10-in. cast-iron pipe. This is furnished by the Chattanooga (Tenn.) Pipe Foundry. There will be 22 Adams hydrants, and a pressure of from 72 to 120 lbs. The cost of th works will be $30,000, covered by 6 per cent. bonds. The works were designed by A. A. RICHARDSON, Lincoln, Neb., and are being built with BEN. S. CLARKE, Tecumseh, Neb., as general contractor and consulting engineer. The boiler was made by Wilson & Co., Omaha, Neb. Population, 2,000.

GEO. W. KEY.

HILLSBORO, Tex., Dec. 10, 1888.

EDITOR ENGINEERING NEWS:—Our population is 3,000 and our water supply is from wells. According to my judgment the best source for a general supply would be gang wells, and I think that if a suitable company made a fair proposition the city would grant a franchise. We will not promise much outside of 20 or 25 years' franchise I am sure all private families would take water, and the city might use some fire hydrants.

G. B. BALLARD, *Mayor.*

POMONA, Cal., Dec. 7, 1888.

EDITOR ENGINEERING NEWS:—The Pomona City Water-Works Co. is building works to supply our city of 5,000 inhabitants. Water is taken from artesian wells, the natural head being sufficient for all purposes. The works are estimated to cost $150,000. H. A. STORRS is the company's engineer, and B. S. NICHOLS our president. We do our own work. F. L. PALMER, Secretary.

SPRINGER, N. M., Dec. 11, 1888.

EDITOR ENGINEERING NEWS:—Our well and reservoir are constructed, and the pump and boiler purchased and here. All that is now needed is the piping, which will be bought as soon as satisfactory quotations are received. The contracts are let to local parties, and the work is under the immediate charge of W. W. JACOBS, of this place. Our population is about 750, and our supply has been from a few wells and a tank-wagon. The new supply will be pumped from a large well to a reservoir. The works are being built by the Crystal Water Co., a corporation composed of citizens. The works will cost $10,000. Our officers are: Vice President, P. P. TALLE Treasurer, E. CLOUTHIER; Secretary, HENRY STURGES and MELVIN W. MILLS, *President.*

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated).

CONTINUED FROM PAGE 458.

Ord, Neb.—The works were commenced Oct. 15, 1887, and completed Dec. 4, 1887. They were designed and built by S. K. FELTON, of Omaha, Neb.; the pipe, specials, valves, hydrants and pumping machinery were furnished by the U. S. Wind Engine & Pump Co.; Eclipse hydrants and Galvin valves are used. The supply is by gravity and direct pumping; the water is taken from driven wells and the reservoir has a capacity of 5,300 bls.; there is a Knowles duplex pumping engine, with a daily capacity of 750,000 galls. and a Porter boiler. There are 2¼ miles of pipe, 14 hydrants and 40 taps; no meters; the mains are of kalamein pipe, and the service pipes of lead. Ordinary pressure, 40 lbs fire pressure, 125 lbs. Cost of works, $14,000; debt, $12,000, bonds; rate of interest, 6 per cent. Annual expense, about $1,000. The works are owned by the city. Present population, about 1,500.

Cedar Falls, Ia.—The works were commenced in the spring of 1888, and completed in August, 1888; at the date of our special report, Aug. 14, 1888, they were completed with the exception of the water tower. The engineers were LOWETH & CURTIS, of St. Paul, Minn.; and the contract for construction was taken by the American Water & Gas Works Construction Co., of Chicago; the tank was built by Wm. Lee, of St. Paul, Minn. The supply is taken from springs and pumped to a tank 20 ft. × 30 ft. on an iron pier 70 ft. high, by a Worthington duplex high pressure pumping engine with a daily capacity of 1,000,000 galls. There are 3 miles of pipe, 34 hydrants and 3 meters. Ordinary pressure, 80 lbs. Cost of works, $31,000. The works are owned by the city, which has issued bonds. The present population is about 4,000.

Hiawatha, Kan.—The works were designed by J. W. NIER, of Kansas City, Mo., who was also Constructing Engineer, and the contract for construction was taken by R. P. McCormick, of Kansas City. The supply is drawn from a system of small wells and pumped to a stand-pipe 12 ft. diameter and 130 ft. high, by a Dean pump. There are 3½ miles of pipe, 35 hydrants, 65 taps and 2 meters; the mains are of cast-iron. The works are owned by the city, which has issued bonds for $50,000. Present population, 4,000.

(TO BE CONTINUED.)